HOMICIDE INVESTIGATION

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PRACTICAL INFORMATION FOR
CORONERS, POLICE OFFICERS,
AND OTHER INVESTIGATORS

Revised and Enlarged Ninth Printing

By

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To

Those unknown and uncounted persons,
prematurely deprived of life by malicious assault,
and whose assassins have gone unpunished—
this book is respectfully dedicated.

Foreword

THE investigation of death imposes upon the investigative services a responsibility of the first magnitude Society has placed homicide at the top of the agenda in the catalog of criminal offenses and to this phase of criminal investigation should be addressed the finest resources at our command

It is not enough to know that modern laboratory facilities and the services of the pathologist and other experts are at the disposal of the investigator Probably the most critical stage in homicide investigation is that period immediately following the arrival of the coroner, police officers and other investigators at the scene *What not to do* is equally as important as *what to do* in terms of preventing the contamination mutilation, destruction and loss of important evidence that may make the difference between a cleared case and a costly, extended investigation

This book, *Homicide Investigation*, by Dr LeMoyne Snyder provides the answers Written in clear, concise style and profusely illustrated it offers to the field a text and manual in the investigation of death which should be in the possession of coroners police personnel and other investigative officers everywhere Out of the wealth of his professional experience and practice, Dr Snyder has brought together in easily read easily understood form, the cardinal rules that should govern this important category of criminal investigation

The fact that *Homicide Investigation* went into the ninth revised printing is eloquent testimony to the rapid gains we are making toward the day when the killer may anticipate with certainty the results of his act and when no man ever again will spend tortuous days in condemned row for a crime that had never been committed Here, in the revised edition of *Homicide Investigation*, will be found added assurance that the so called 'perfect crime'—not a perfect crime, but the end result of an

imperfect investigation—is being moved aside by increasing perfection in the investigative skills and techniques of the American police forces and other law enforcement personnel

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Preface

IN THE INVESTIGATION of deaths suspected of having been due to violence, the need for scientific methods has become increasingly acute in the United States during the past few years. Except in just a few localities, no responsible organization exists in the United States and Canada to correspond with the soundly established medicolegal institutes in Europe and Latin America. However, some North American cities and counties have developed astonishingly well equipped laboratories to help police agencies investigating violent deaths.

But the finest laboratory is powerless to give practical assistance unless there has been an equal degree of scientific work done on the case at the time when the dead body was *first found*. And in only a few areas have investigating police officials received adequate training to enable them to perform this important task. Consequently, when attempting to deal with their special and important public problems, the investigating officers may do certain things or fail to do others which result in the criminal case becoming hopelessly involved.

So it may be said that the purpose of this book is to make available to coroners, police officers or others, whose duty it is to inquire into the nature of a homicide, tested practical plans of procedure to follow in adequately investigating the death. Scientific names, which are not self explanatory, have been eliminated, and it is intended that this book shall be simple and practical. The trained medical examiner may find little of interest in these pages, but it is hoped that this synopsis of factual information will be of practical use to men without scientific training whose duty requires that they shall investigate what appears to be a violent death.

Outside of our larger cities, it is usually impossible for the investigating officer to have the services of a trained medical pathologist to perform autopsies which may be required. Generally the community doctor is the man called upon to do this

task, and, if he is without special training in the field of legal medicine, the autopsy is apt to be entirely inadequate. Consequently, with each chapter dealing with a particular type of homicide, there has been outlined a brief section which covers the medical aspects of that particular type of death It is suggested in many instances that the coroner or other investigating officer will find it of advantage to have the doctor read such sections prior to performing the autopsy. If this is done, serious errors of commission or omission will not be so apt to occur.

L. M. S.

Paradise, California
October, 1958

Acknowledgments

To name individually all the persons who have contributed ideas pictures and information to help make this book is an impossible task But to V A Leonard, America's outstanding contributor to modern police methods who wrote the Foreword and to Charles Wilson, Clarence Muehlberger and Alex Gregory each of whom wrote chapters—my sincerest and deepest thanks

From the Atlantic to the Pacific material has come from a host of friends and experts in this field From London to Vienna has likewise come information, new ideas, solid facts which have been incorporated in this new edition All have been most generous in helping in every possible way and to all of them my sincere thanks

Charles C Thomas, the publisher, has taken a tremendous personal interest in this book and his varied and unusual talents have proved invaluable

And finally to Louise Drew Snyder, who has spent uncounted hours on this task—thanks and more thanks!

Contents

HOMICIDE INVESTIGATION

CHAPTER 1

General Considerations of Homicide Investigation

RESPONSIBILITY OF THE INVESTIGATING OFFICER

APPROXIMATELY *twenty per cent of all persons die under circumstances that require an official inquiry into the cause of death.* Therefore, the coroner or police officer carries a heavy responsibility when called upon to investigate a sudden or violent death, *for he stands in the dead man's shoes to protect his interests against those of everyone else in the world.* The zeal and intelligence which he brings to bear on the problems confronting him may make the difference between a murderer being convicted or a homicide not even suspected. If he interprets an accidental death as due to natural causes, a widow and family may be deprived of benefits and other property which the deceased may have gone to great pains to provide If he interprets a death due to natural causes as a homicide, an innocent person may be placed in jeopardy and put to extreme discomfort and expense to defend himself. Consequently, the investigating officer must proceed with extreme caution and with a full realization of the disaster which may result from a mistake on his part.

The investigation of a violent death is quite different from most other types of scientific work because a mistake once made cannot be corrected, and further work on the case, however well done, may be of no avail

Much nonsense has been written about the "perfect crime" never having been committed Actually any crime is perfect if there is no resulting conviction of the person responsible The United States Uniform Crime Reports is an official publication covering the statistics from 201 cities of over 25,000 population

For the year 1954, these figures show that for every three persons charged with murder and brought to trial, only two are convicted Of those tried for negligent homicide, the number found guilty is considerably less than half

Stated another way the Uniform Crime Reports show that *for every two murders reported there is only one conviction,* for the crimes of rape and negligent homicide there are three known offences for each person found guilty and for robberies and aggravated assaults the ratio increases to four to one In view of the fact that these 201 cities with a total population of approximately 25,000,000 probably represent the best in homicide investigation in the country, it would seem likely that if statistics were available for the remaining 140,000,000 inhabitants they would be even more discouraging

The Investigator Burns Three Bridges Behind Him—*In* the course of conducting his investigation the officer crosses three bridges which he burns behind him It is vitally important that the case shall be adequately handled ***before these bridges are burned.***

Bridge 1—The first bridge is burned when the dead body is moved ***Before this is done,*** it is *imperative* that photographs be taken, measurements made, fingerprints searched for and a host of other tasks carried out, because, when the body is once moved, it can never be put back again and the investigation repeated ***exactly***

Bridge 2—The next bridge is burned when the body is embalmed Embalming effectively destroys traces of alcohol, cyanide, carbon monoxide and several other poisons It also makes the determination of many other substances (see page 263) much more difficult If blood stains are an important factor in the investigation, it is practically impossible to determine if they came from the deceased Consequently, if there is the slightest reason to suspect poisoning, ***the organs should be removed before embalming.***

Bridge 3—The investigating officer has burned his last bridge when the body has been buried or cremated It is a difficult and expensive procedure to disinter a body The lapse of time greatly increases the difficulties of a scientific examination and diminishes the likelihood of a successful

conclusion as to the cause or instrument of death Cremation, of course, destroys any possibility of further scientific work on the body

THE MEDICOLEGAL AUTOPSY

The real beginning of any homicide investigation should be to establish the cause of death accurately Frequently time and money are spent on checking up rumors, listening to the theories of casual neighbors and relatives, or of even searching for a murderer when there is no adequate proof that a homicide has been committed Consequently, an autopsy should be the first thought of the coroner when there is the slightest reason to suspect the possibility of a homicide *A medicolegal autopsy* requires a much higher degree of care and thoroughness than do autopsies generally The pathologist must not be content with merely establishing *the cause of death* He should carefully examine the entire body to rule out *all other possible causes or contributing factors to the death*

When the examiner feels that a postmortem examination is required, he should *proceed with care in his selection of the physician to do the work* Experience and training in this particular field far outweigh any amount of good intentions Performing an autopsy is an expensive procedure but the microscopic examination and the determination of poisonous substances in the tissues removed cost much more if the autopsy is inadequately done The laboratory work to follow a superficial autopsy has not much value It is far cheaper in the end to pay the cost of having a physician experienced in this particular field perform the autopsy than it is to try to get by with the minimum of expense

There are certain minimum requirements for performing an autopsy properly It should not be done outdoors unless the state of putrefaction is so advanced that it is impossible to attempt it inside Running water is helpful Most funeral directors with modern equipment have embalming rooms with a tilting table, and with adequate lighting, plumbing and ventilation to carry out the operation properly Their equipment should be utilized whenever possible

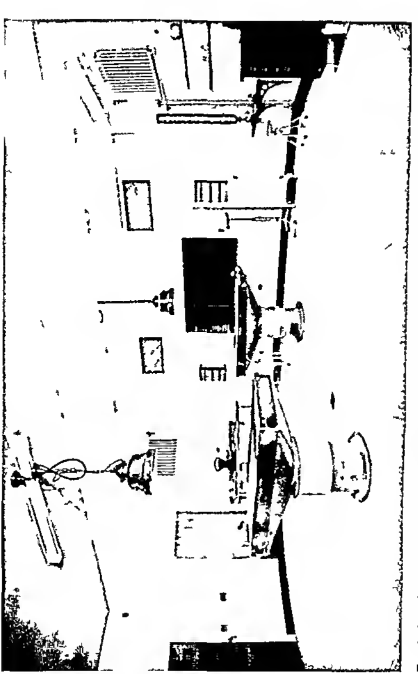

Fig 1 A modern autopsy room Note the roominess adjustable lighting modern tables and the refrigeration room at the left From Farber's *The Postmortem Examination* (Courtesy of Charles C Thomas Publisher Springfield, Ill)

Fig. 2. An autopsy on a decomposed body. Compare the facilities here, which are usual, with those in Figure 1, which are unusual

The officer in authority should bear in mind that an autopsy is not a sideshow and ***persons not officially concerned with the investigation should be excluded from the autopsy room.***

Cases are on record where the surviving relatives of the deceased have collected damages against persons performing the autopsy when newspaper reporters, curiosity seekers and others have been present. The awards have been granted by the courts on the basis that their feelings have been outraged by the lack of privacy at the examination.

At most autopsies it is necessary to remove and retain portions of organs, bullets or other material for the purpose of further scientific examination In the chapters to follow details will be given as to how this material should be preserved In general it may be stated that organs or portions thereof should be placed in *clean* glass top fruit jars and the lids *sealed with sealing wax* If the purpose is to examine the organs for poisons no preservative of any kind should be added The jars should then be labeled with the date of the autopsy, the name of the deceased, and the name of the doctor who made the examination It is important that the jars pass through as few hands as possible *because if the case comes to trial every person who handled the materials must be put on the witness stand to show his connection with the evidence* In general the material cannot be sent by mail or through other commercial channels to a laboratory but must be carried in person and a receipt obtained from the individual to whom it is delivered

What Cases Should Be Autopsied?—Coroners frequently ask what cases should be autopsied It is impossible to answer this question in a manner which will apply to all circumstances Frequently the officer is confused when the cause of death seems to be apparent For instance a man is found dead with what appears to be two or three bullet holes in the body and the officer wonders whether a postmortem examination is required *In general it may be stated that when a death has apparently been caused by violence, an autopsy should always be performed unless there is adequate proof at hand that death was due to suicide* All cases of death of unknown cause deaths due to abortions suspected poisoning or the negligence of other parties should be autopsied

Even when a careful autopsy is performed, sometimes the cause of death remains in doubt Probably the type of case which causes most trouble is the sudden death due to no apparent cause Shock, fright and other factors may be involved which are extremely difficult to determine

UNUSUAL CAUSES OF MURDER

The many causes of murder are outside the scope of this book Motivations and passions which may finally be activated to the

point of murder are complex and varied Establishing a motive such as revenge, robbery, or jealousy may greatly facilitate an investigation, but many of the most brutal homicides seem to be without incentive of any kind Investigation of these is frequently very difficult

One rather common type of murder without apparent motive is the *juvenile compulsion murder* This is usually committed by a teen age boy, and the victim may be anyone, even his best friend When apprehended and asked why he did it his answer may be "I don't know I just had a feeling I had to kill someone" Upon examination by psychiatrists he may reveal little or nothing mentally wrong with him

Another type of homicide with which the officer should become familiar is that committed by an adult who suddenly becomes maniacal and kills a person for no apparent reason These murderers are generally apprehended immediately and should be given a thorough physical examination at once, because they frequently are suffering from an *acute infectious disease* I recall several cases in which the murderer was found to be suffering from a severe case of pneumonia, but other acute infections such as meningitis may cause the same thing There is also the whole field of mental illnesses and disturbances induced by drugs, alcohol and sexual abnormalities which play their part in causing the destruction of human life

DISPOSAL AND DISCOVERY OF MURDERED BODIES

Frequently a murder is committed under circumstances where the murderer has no fear of immediate discovery He then may go to great pains to dispose of the body in such a manner that even if the crime is discovered the body is not likely to be found Some resort to excessive mutilation The head and limbs may be removed, marks of identification obliterated and the various sections of the body disposed of at widely separated points Others may attempt to burn the body or dump it into a river or lake

The most common method, however, of attempting to hide a murdered body is by burial Of necessity, this requires hard manual work, tools and a suitable location In cities and towns

burial is frequently undertaken in the basements of houses, in rubbish dumps, or even in the yards of homes In more isolated places burial may be attempted around farm buildings, in fields and woods, and occasionally the body may be transported great distances for burial in some unlikely spot

Almost always the body is merely dumped in the hole and the earth filled in around it A box or receptacle to confine the body is rarely used

Locating the dead body is a task that requires great ingenuity and the use of a polygraph is extremely valuable for this purpose The area where the body might be lying can be mapped out in squares, and the suspect interrogated with respect to each square If he responds to one particular area, that may be further subdivided until the location to which he responds is very small He then may be questioned with respect to certain prominent points in that particular location such as a garden, a fence row, a barn floor or other place I have seen this technique accomplish remarkable results on several occasions

When searching for a dead body in the basement of a building it is well to remember that often a body is buried under the floor and is then covered with a coal pile or an ash heap Always be suspicious of what appears to be a new cement floor In rural sections one of the best clues of a new grave is the character of the vegetation covering it I recall one case when a body was buried in a desert The vegetation was very sparse and consisted of small plants one or two inches high, while over the grave there was no plant life of any kind

Disinterment of the Body —When a grave has been located the officers must use great care in removing the body, and *it is necessary to excavate a much larger area* than the original grave After the body has been definitely located further digging above or in close proximity to the body must be abandoned Remove the earth around the body until the excavation is well below the area where it is resting, leaving the corpse on a pedestal of earth Then proceed to carefully remove the earth close to the body with a trowel, kitchen spoon or preferably with the bare hands This precaution is necessary because it is often difficult to establish the cause of death if the corpse has been buried for a considerable time If a pick or spade is plunged into

the body this determination is made more difficult or even impossible After the dirt has been carefully removed from above and around the corpse it should be photographed in the position in which it is found

Planks should then be lowered to the level of the earth on which the body rests, the body gently shifted onto the planks and then transported to the examination room without disturbing its original position The autopsy surgeon may then proceed with his examination knowing that he does not have to contend with postmortem wounds produced by the disinterment

THE DYING DECLARATION

When a person has been feloniously shot, stabbed or assaulted and it appears that death will undoubtedly ensue, the dying declaration is of great importance and the coroner should obtain one if at all possible ***A dying declaration is important because it is one of the few types of hearsay evidence which may be introduced at the trial to convict the murderer*** It does not have to be in writing or notarized and, if the essential requirements are fulfilled, it is often the most damaging evidence that can be introduced on trial

The elements of a dying declaration are simple and while the requirements may vary slightly in different states, they are substantially as follows

1 *The dying declaration must be made when the person* believes that he is going to die and that hope for recovery is gone It is not necessary, always, that he shall be told by his physician that there is no hope for recovery but, if his actions and speech indicate that this is his belief, the requirement is fulfilled

2 *The dying statement must refer only to the manner* and circumstances which brought about his present condition and ultimate death, and name those responsible

3 He must die

4 The statement may be used only in a criminal trial for the felonious causing of the declarant's death

If feasible, it is well to reduce the statement to writing and have the declarant sign it or make his mark but this is not an

essential requirement No oath has to be administered nor is it necessary that other witnesses shall be present although it is well to have other witnesses if possible *In some types of homicides it is almost impossible to obtain a conviction without a dying declaration* This is particularly true in deaths due to criminal abortion

ARREST OF THE SUSPECT

When a person is arrested and charged with murder, he generally demands his right to consult an attorney at once Usually his counsel will advise him not to discuss the case with anyone and to refuse to submit to a polygraph test or other scientific measures which might increase the proof of his guilt Consequently *a most valuable source of information to the investigating officers is nullified when the suspect is placed under arrest* The premature arrest has proved disastrous in many important cases The decision as to the proper time to make the arrest is a matter requiring tact and long experience in modern police methods Generally it is far better to build up the case logically and scientifically If it is necessary to contact the suspect in connection with the investigation it should be done in a most casual manner and when the suspect is properly handled he can nearly always be persuaded to take a polygraph test before he has been arrested and employed counsel The danger of the suspect running away and thus avoiding prosecution is not nearly as great as is generally believed Sooner or later he can usually be located His flight is additional evidence of his guilt

CHAPTER 2

Examination of the Scene of a Homicide

IF A MURDER investigation ends in failure, the cause is usually an inadequate examination of the scene of the crime When an investigator arrives upon the scene of a violent death, his activities during the first 15 minutes will largely determine the success or failure of the complete investigation

When an officer is first informed of the discovery of a dead body, he cannot possible forsee the future developments of that particular case Perhaps it is a death due to natural causes or a suicide. However, it may turn out to be a homicide of major importance or possibly the subject of civil litigation five or six years hence. Consequently, if errors are to be avoided, it is necessary that the investigator adhere to a rigid routine in his examination. He may perform many tasks which later events will show were needless, but which will nevertheless, effectively and methodically block every possible avenue of failure to the investigation.

In view of the great variety of types of violent death, it is impossible to outline a routine examination which will be applicable to all conditions, but the basic principles can be described which may be modified to fit any particular situation Thus it is the purpose of this chapter to set down and explain these steps in their logical order.

Necessary Equipment.—The only equipment necessary for an investigator to conduct a first-at-the-scene examination is:

1. Loose-leaf note book
2. Steel tape

However these must always be available to the officer on a moment's notice and it is well to have them as part of the standard equipment of every police car.

Many will wonder why it is stressed that the notebook be of a loose leaf variety The reason is because there is always the possibility that months or years hence the officer may be a witness in court and require those notes to refresh his memory with respect to details of the investigation At some period during the cross examination an exchange of words between counsel and the witness usually takes place about as follows

Question What is that you have in your hand?

Witness These are my notes I have with me to refresh my recollection

Question When did you write them last night?

Witness No I wrote these at the time I made the investigation

Question Let me see them

Thereupon the counsel takes them and while standing in front of the jury goes through the note book page by page If he can find anything in the note book to embarrass the witness he is sure to do so Consequently it is important that all material referring to other cases or to matters not connected with this particular investigation be removed prior to coming into court

Recently a police officer was on the stand and his note book was taken over in the above manner by the defense attorney In going through the note book in the presence of the jury he came across two lewd photographs It is needless to say that this incident destroyed the value of this witness testimony *An excellent rule to follow is never to go into a court room expecting to testify with anything on you or about you which you are not perfectly willing to have displayed in open court*

Preliminary Procedure —When an investigator is first informed that a dead body has been found or that a death by violence has occurred frequently his first act is to immediately jump in his car and proceed at full speed to the scene *If he does this he has started out by committing a serious error* because there are several important tasks to be done first

On receiving the above information his first act should be to set down on a fresh page in his loose leaf note book the following information

1 The date
2 The exact time that he received the call
3 Method of transmission of the call (radio telephone or other means)
4 The name of the party transferring this information

This requires only a few seconds of his time but as will be explained later is vitally important Taking the note book and tape with him he should now proceed promptly to the location of the death

On arriving at the scene and before leaving his car he should next set down in his note book

1 The exact time of arrival on the scene
2 The exact address
3 A brief note about weather conditions

One might wonder why stress is given to such elementary items as these There are two principal reasons for emphasizing this matter The first is that in a surprising proportion of murder trials *the defense relies principally upon an alibi with respect to time* It is not uncommon particularly if several months have elapsed that the investigator has only a vague idea of what time he was notified and arrived on the scene Thus it becomes impossible to properly refute the alibi

An even more important reason is that the question of time is frequently the first subject brought up in cross examination If the witness has no accurate knowledge in regard to these elementary parts of his investigation the value of the rest of his testimony is minimized The jury receives the impression that if the officer has no definite knowledge with respect to this matter little weight should be given to anything else he has to say On the other hand a witness who begins his examination by reciting accurately the hour and minute that these events occurred has strengthened the value of his entire testimony

Upon leaving his car the next duty of the officer should be to view the body to make certain that death has actually taken place Generally a glance is all that is necessary to determine this matter but occasionally there are circumstances where a more thorough inspection is necessary as detailed in Chapter 3 This is particularly true when death has been due to suffocation,

drowning electric shock or poisoning from sleeping tablets If there is the slightest doubt in the observer s mind as to whether or not death has taken place he should proceed as if the body were still alive Artificial respiration should be started immediately and medical aid summoned

Preserving the Scene of the Homicide —After assuring himself that the body is dead the next duty of the investigator depends upon circumstances but his efforts should be directed toward effectually and yet tactfully isolating the body and the immediate surroundings from all other persons If the dead body is in a house or apartment this task is fairly easy but it requires a great deal of tact to deal with members of the family sympathetic neighbors newspaper reporters and strangers who are there out of curiosity The immediate family and friends can be *ushered into another room The curiosity seekers should be ex*cluded from the premises However it is important that the officer in his zeal to perform his duty properly does not antagonize or drive away persons who may be important witnesses and might give him valuable information There is probably no situation in the whole of police practice which so effectively distinguishes a high class police officer from one of mediocre caliber as the manner in which this task is handled

The need for isolating the premises is to *preserve the dead body and the immediate surroundings exactly as they were when the death took place* Otherwise articles are picked up off the floor furniture set back in position valuable evidence is destroyed and numerous fingerprints left on all manner of objects Another reason for excluding those who do not have an offic al duty in connection with the investigation is that if they are allowed to remain any one of them may become a witness at a trial months or years later This has happened in many cases to the embarrassment of the prosecution because the witness should not have been allowed on the premises in the first place

If the dead body is out in the open although the circumstances may be greatly altered the principle remains the same For instance consider the situation in which a dead body is lying on a sidewalk at the entrance of a store during business hours A large crowd has gathered around blood is running

down the sidewalk and the store manager wildly demands that the gruesome remains be removed at once. Here again the officer is confronted with a very difficult situation which requires a great deal of tact. *A waterproof sheet should be part of the equipment of every police car* and this should immediately be placed over the dead body without otherwise disturbing it. Following this the crowd can be moved back to a proper distance and the area roped off if necessary. It is imperative that this be done because the investigating officers have several important duties to perform before the body is removed. Under no circumstances should the officer immediately accede to the pleas of the store manager or others to remove the body from the street until these other functions have been performed.

I recall an occasion when I investigated a situation in a small community where the town marshall and another citizen were both lying dead on the sidewalk at the main intersection. It was late at night and raining hard. There were the usual pleas to remove these gruesome objects from the sidewalk and, being inexperienced in this business, I complied with their requests before I should have. Luckily for me no serious harm resulted on this occasion, but it was the wrong thing to do and easily could have proved disastrous.

Describing the Scene.—After the preliminaries have been properly attended to, the next duty of the investigating officer is to write in his note book a complete description of the dead body and the immediate surroundings. This is to be done without moving the dead body, touching or changing anything. The description of the deceased should include the sex, appearance, age, a general description of the type of build, color of hair, clothing and finally evidence of injury. If blood is visible on the figure, it should be stated whether it appears to be fresh or dry blood. Tears in the clothing, evidence of gunshot or stab wounds should likewise be described. *It is particularly important that a description of the hands be given*—such as whether or not objects are held in the hands, whether there is blood or evidence of injury. If nothing of significance is seen on them that also should be stated.

After the body has been carefully described, the immediate surroundings should also be noted in detail. The position of the

body with reference to all articles in the room—a description of furniture, windows, doors, and stoves should also be made If a weapon is nearby a careful description of it should be written without picking it up If a firearm is nearby, generally the make, the caliber and type of weapon can be determined with out touching it Following this, a careful search of the room or surroundings should be made for bullet holes in the walls ceil ing or furniture, for fired shells or other instruments of violence If there is a possibility that poison has been taken, a careful examination of all glasses, bottles medicine cabinets, bathroom or woodshed should be made ***Never be afraid of writing too much*** in the way of describing what is seen at that time

There are two reasons why this minute description of the dead body and the surroundings is so important

1 The first reason is that if an investigation is conducted in this manner the officer is likely to see many things which otherwise would be overlooked Writing it down while he is looking at it assures much greater accuracy and makes his testimony at a later date much more effective
2 Another important reason is that at this stage of the in vestigation the officer does not have any preconceived ideas as to who the murderer might be or exactly how it was accomplished If he waits until a later date to write up his notes he is apt to have a theory as to what hap pened and he is subject to that very human tendency to overemphasize those observations he recalls which fit into his theory of the case and at the same time minimize those which are incompatible The result is that entirely uncon sciously he has written a distorted description of what he actually saw The ***common error*** then results in trying to make the observations fit his theory rather than construc tion a theory to conform with unbiased fact

Sketching the Scene—The next duty of the investigating officer is to sketch the scene of the crime in the following man ner He should draw an outline of the room, placing in it the doors, windows, chimney and other fixed objects This is done freehand on a blank sheet of paper He then should put in the furniture such as piano, stove, chairs and other objects, and

finally sketch in the dead body in relation to these articles With the steel tape, measurements may then be made of the size of the room, fireplace, sink, doorways, etc and then the accurate distance of various parts of the body from these stationary objects noted At some later time, an accurate drawing may be prepared showing all of these details in proper scale The reason for doing this is that photographs which are to be taken later may easily give a distorted view of the relations of the body to these fixed objects as is graphically shown in the illustrations (Figures 5 and 6) This is particularly true where the body lies in a small space, such as a hotel bathroom or small bedroom

Photographing the Scene—In homicide investigation, good photography is of great importance and yet it is usually very poorly done Again the old adage applies that "good intentions are no substitute for experience and training" To properly photograph the scene of a homicide not only requires the services of a photographer who is skilled and trained in this particular field, but a variety of special photographic equipment, lights and other accessories It is far better to wait two or three hours and have the work done properly than to trust it to an amateur with the general result that the pictures are worthless The dead body must be photographed from every conceivable angle which may require the use of step ladders and wide angle lenses Bullet holes may be found in the furniture or walls which can be photographed properly only by using a camera with a double extension bellows Photographs which are worth having cannot be taken in five or ten minutes It is well worth while to get a skilled photographer with suitable equipment and allow him all the time he needs to do the work properly

The investigator has now approached the time when he is about to cross the first bridge as described in Chapter 1 If other investigators are available during this time, one assistant may meanwhile interview the family, witnesses and others who may be of help

Errors to be Avoided—However, there are a few things which should not be done during this first phase of the investigation

1 Do not allow fingerprints to be made of the deceased The

proper time for that is later. Likewise do not allow furniture or other articles to be dusted for fingerprints until after the photographs have been taken and the body removed.

2. Do not smoke nor allow others to smoke in the room or vicinity of the dead body. Occasionally it happens that

FIG. 3: Scene of a homicide

burned matches and cigarette butts become important pieces of evidence. In at least one celebrated case this evidence was valueless because of butts and matches left by investigating officers.

3. Do not allow yourself to be photographed with the dead body or with a captured suspect. It can never do you any good and sometimes such pictures prove very embarrassing at the trial.

4 Do not express a theory to newspaper reporters as to what happened or who is guilty In particular never at any time say you know who the murderer is and will have him in custody in a short time A statement of that kind often backfires with disastrous effects

Moving the Body —After the coroner has viewed the body and authorized removal it now may be taken to the morgue *following which a fingerprint expert should make a careful ex*

Fig 4 Another view of the scene of the same homicide in Figure 3 Elements shown which might be of importance in the solution of this case include Position of the body knife in right hand cigar blood stained clothing pool of blood telephone condition and quality of clothing hat safety razor blade telephone book condition of the dresser

amination of all pertinent objects in the room or vicinity If it appears at this time that a gunshot wound was the cause of death it is well to protect the victims hands until a dermal nitrate test can be performed at the morgue This is best accomplished by *putting a clean paper bag over each hand* and tying it with a string around the wrist The hands will be preserved so that scientific tests may be properly conducted

In picking up the dead body to transport it to the morgue there are *certain precautions* to be observed particularly if gun shot wounds appear to be the cause of death Frequently a bullet may go completely through a body and lie loosely in the clothing on the opposite side so that it falls out when the body is picked up This bullet may be the most important piece of evidence in the case and is apt to be overlooked if precautions

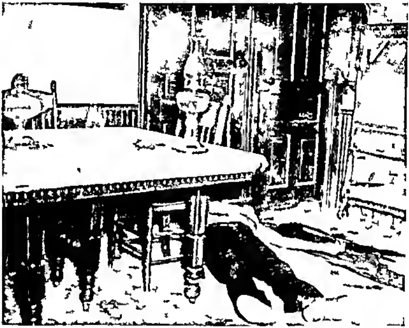

FIG 5 View of the scene of a homicide Where does the body lie in relation to the table? See Figure 6

are not taken Especially is this true when the body is lying on the ground and the fall of the bullet makes no noise

Occasionally a victim will be lying on the ground while some one stands directly over him and shoots him These fired bullets may be underneath the body or buried loosely in the upper inch of soil Be sure to make a careful examination of the ground underneath the dead body to make sure that such a bullet is not overlooked

If all the details enumerated have been complied with up to this point, the body may now be moved to the morgue and the investigator may safely burn his first bridge behind him

PROCEDURE AT THE MORGUE

When the body has arrived at the morgue the first duty is to remove all of the clothing and as every article is removed an identification tag should be wired to it On this tag is to be

FIG 6 Another view of the scene shown in Figure 5 These two pictures show realistically how photographs may be misleading and emphasize the necessity of making a sketch with accurate measurements of the locale as shown in Figure 7

written the name of the deceased if known the date and the name of the coroner or investigating officer The various articles of clothing removed should also be noted in the investigator s loose leaf note book If the clothing is wet or blood soaked hang it up carefully on hangers and when thoroughly dry it may be folded and placed in a box or suitable container No matter how badly damaged it may be under no circumstances destroy or throw away any item of apparel until the case is completely disposed of

Be very careful that no damage is done to the clothing during the removal Remember that every garment went on in an orderly fashion and it should be removed in the same manner

Buttons should not be pulled off Rents or tears should not be enlarged as it is important to preserve the clothes in exactly the same condition in which they were found on the dead body

If it appears at this point that death was caused by gunshot

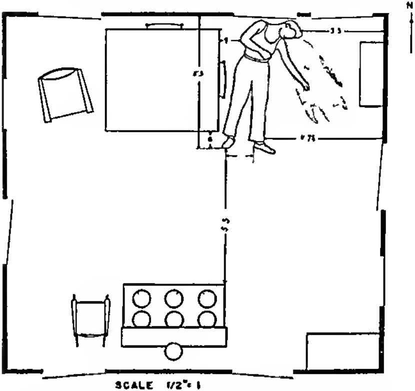

FIG 7 A sketch of the scene of the homicide shown in Figures 5 and 6 Both of the photographs (Figures 5 and 6) and this sketch (Figure 7) are necessary to accurately portray a crime scene

wounds or that the deceased may have fired a weapon a dermal nitrate test should be made on both hands and after this is completed the identification expert should take a set of fingerprints from all fingers Some may wonder why this is necessary particularly if the deceased is already known The purpose is to differentiate prints found at the scene of the crime from those made by the deceased Consequently it is always well to have on hand a fresh set of the victim s prints

Photographing the Dead Body—The services of an expert

FIG 8 Evidence discovered by photography This body was examined by eight investigators, none of whom noticed the double circle on the left buttock This circle corresponded to the inner surface of a hubcap on which the body had lain in the trunk of an automobile and has been so depleted of blood that there is practically no postmortem lividity This photograph which reveals the double ring was made by usual methods panchromatic film and flash gun (Courtesy of H G Cliff Golden Colorado)

photographer are again required to photograph the dead body before blood and other grime is removed These pictures should be taken close up and usually necessitate using a camera with double extension bellows Following the taking of these pictures, the areas of the wounds should be carefully cleaned and photographs again taken, showing in the greatest possible detail the wounds which caused death Pictures of the bullet holes or stab wounds taken several feet away have little value To properly take good pictures requires special lighting equipment, various accessories and often propping up the body

It is particularly important that in the photographs of wounds a 6 inch celluloid scale be included in the photograph so that

FIG 9 Photograph of a footprint in snow in a railroad yard The new heel plate shown in the picture led to the tracing of the murderer (Courtesy of G Russell Carner)

regardless of the size of the finished print the dimensions of the wounds can be measured accurately

A mortician is usually anxious to embalm the body at the earliest possible moment and ***if this is done before an autopsy has been performed, the entire investigation may be ruined*** Embalming makes it impossible to determine whether the deceased had been drinking or was under the influence of liquor There are several important poisons which will be completely destroyed by embalming and even those which are not destroyed are rendered more difficult to recognize by a chemical examination It is impossible to determine the blood type of an embalmed body If the deceased had been shot or stabbed trocar wounds frequently make it very difficult if not impossible to determine which wounds in the internal organs were made by bullets or by embalming instruments It is not uncommon that persons will suffer a natural death due to clots in blood vessels which will be dislocated and washed away by embalming fluid Consequently if at all possible ***always have the autopsy performed prior to embalming*** Remember that when the body has

been embalmed the investigator has burned his second bridge behind him

The Autopsy—A medicolegal autopsy is a painstaking procedure regardless of the apparent cause of death A complete autopsy should be performed which includes the examination of the skull brain and all of the organs of the neck chest abdomen and pelvis Sometimes amazing facts will be disclosed when least expected

For example take the common situation in which a young woman is found dead and the apparent cause of death is gunshot wounds in the head Immediately the question of whether it was a homicide or suicide presents itself and it may be that this point can be determined with little difficulty However sooner or later, the question of a possible pregnancy is likely to appear and is a matter which should be settled at the time of the autopsy I do not believe any doctor has ever had occasion to regret that he did too thorough a job at an autopsy It is well worth while to go to the trouble and expense of hiring a physician who has had experience and training in this field rather than acquire the services of a doctor without proper qualifications for this work

When the autopsy surgeon has completed his duties he will have dictated a complete step by step report of the autopsy which includes an accurate description and location of all wounds He also will have removed many of the organs of the body for microscopic examination and chemical analysis The method of handling these articles is carefully described in another chapter

The investigator will now have in his loose leaf note book a complete description of the scene of the crime and the dead body He should likewise include in his report a description of weather conditions the apparent method by which the homicide was committed the manner in which the murderer gained access to and left the premises the names and addresses of witnesses and the names and addresses of suspects

The dead body may now safely be released to the mortician for embalming and disposal The embalming will be greatly facilitated if the autopsy surgeon will ligate the large blood vessels which are cut when the heart is removed leaving the strings

long so that these vessels may be easily injected by the embalmer The arteries at the base of the skull which are severed when the brain is removed should also be ligated Care should always be taken to make the scalp incision above the hairline so that a proper reconstruction of the head can be made

If the investigator conscientiously and methodically follows this routine, he will have the satisfaction of seeing many cases successfully concluded instead of filed under the heading of "Homicides—open"

THE GOLDEN RULE OF HOMICIDE INVESTIGATION

Never touch, change or alter anything until identified, measured and photographed **Remember that when a body or an article has been moved, it can never be restored to its original position**

CHAPTER 3

Estimating the Time of Death

OFTEN A BODY is found where the circumstances suggest a violent death has taken place, but no witnesses are available who can testify as to the exact time that the death occurred It is always important to know as nearly as possible the time when the victim expired In the absence of witnesses, this information must be obtained from an examination of the body itself Generally speaking, the sooner after death the body is found, the more definitely can the actual time of death be fixed However, it is usually impossible for anyone to establish accurately the hour and minute when life ceased

Not only in murder trials is it important to determine the time of death, but also in civil cases, the element of time is often of great importance Insurance matters are often directly concerned For instance, the writer once examined the suicide of a young woman who had taken out a life insurance policy which provided that *for a period of one year* from the date that she bought the policy, no benefits would be paid if death was due to suicide *At five minutes after midnight* on the day following the expiration of the one year clause, she took strychnine and fifteen minutes later was dead Fortunately witnesses were present who could state definitely the time of death but had the body not been found until twelve hours later, it would have been impossible to state whether or not the death had occurred before or after midnight and whether or not the suicide exemption clause was in operation

Occasionally a situation arises when a husband and wife are both found dead, with each having separate heirs If the husband expired *even a minute before his wife,* a portion of his estate is automatically vested in her and, after her death, in *her* heirs If she died before her husband, her heirs would not share in his estate *unless they were specifically provided for in a*

will This indicates some of the situations which arise When a coroner or police officer is investigating a violent death, seldom can he foresee the many problems, civil and criminal, which may arise months or years later, and the solution of which may depend upon the accuracy and thoroughness of his observations and investigation

In civil life instant death is a rarity Human life is not often snuffed out like that of a fly crushed under foot A person will sometimes survive for a considerable period following gunshot wounds of the heart or brain and occasionally may actually recover Frequently death comes slowly after a fatal blow has been struck This fact adds to the difficulty of determining the exact length of the time of survival

IMMEDIATE SIGNS OF DEATH

The officer may come upon a body and he may not be sure that death has yet taken place *His first duty is to save life when possible* and if he has the slightest doubt as to whether the body is dead, he should proceed as though the body were still alive and immediately summon medical attention This is most apt to happen in cases of drowning, smothering poisoning by carbon monoxide, or when suicide has been attempted by swallowing sleeping tablets

Many old ideas about determining death are valueless For instance, holding a mirror in front of the mouth sticking needles into the flesh and similar procedures are of no value whatso ever

There are three observations any one of which can be made in a matter of a few moments which are a reliable and accurate means for determining death

1 **Cessation of Breathing** —The easiest way to tell whether a person is breathing or not is to observe his chest closely for a few seconds The best position in which to observe this is with the victim lying on his back and with his clothing loosened over the upper part of his body The place that it is most easy to recognize breathing if it is still present, is in the upper part of the abdomen that is just

below that point where the lowest ribs meet the breast bone If any up and down motion in this area can be detected, *however shallow,* such motion indicates breathing and signifies that life is still present If no motion can be detected, it means that either breathing has stopped or breathing is too shallow to be noticed, but that in itself does not mean that death has already taken place

2 Cessation of Pulse —Under most conditions the heart will continue to beat from a few seconds to even a few minutes after all signs of breathing have stopped To determine this the pulse should be felt at the person's wrist To feel the pulse, place the tips of the fingers on the *under surface of the radius* which is the bone which meets the base of the thumb By moving the fingertips toward the center of the undersurface of the wrist, the pulsation of the radial artery can then be felt if the heart is beating If no pulse can be felt and the person has stopped breathing, it is very likely that death has occurred Both of these procedures can be carried out at the same time

3 Loss of Muscle Tone of the Eyeballs and Changes in the Pupil —The covering of the eyeball is one of the most sensitive tissues in the body and as long as life persists however faintly, that sensitivity will usually be present in some degree Consequently, touching the eyeball with the finger will cause movements of the eyeball or eyelids unless the person is in a very deep coma or dead When death has taken place, the eyelids seem to be very flabby and, when opened, will stay open and will hold their position If open, the eyeballs rapidly lose their luster and take on a dull appearance because of the evaporation of moisture During life, the pupil of the eye will be seen to be perfectly round and the pupils of both eyes will be equal in size Shortly after death, due to the relaxation of the muscles which control the pupil, they will lose their symmetrical appearance, they may differ in size, and, instead of being round, they may be eccentric When all of these signs are present and their determination is but a matter of a few moments, the investigator can be positive that death has ensued

THE BODY CHANGES AFTER DEATH

Loss of Body Heat.—During life the marvelous system that regulates the temperature of the body keeps it at *approximately 98 degrees Fahrenheit under all conditions.* Changes in weather and clothing do not alter this temperature for the body automatically adjusts itself. *After death has taken place, the tem-*

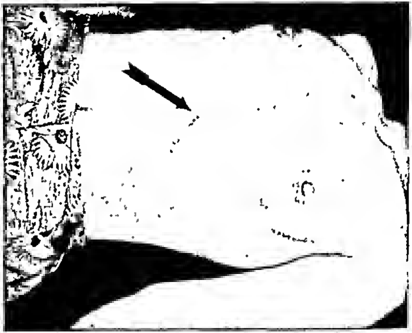

FIG. 10: Examination for signs of breathing. The arrow indicates the place *where breathing is most easily recognized.*

perature of the body tends to become the temperature of the surrounding medium. Consequently, it is impossible to say that a dead body will lose heat at the rate of so many degrees per hour.

The rate at which a body loses heat depends upon the difference of the temperature of the body at the time of death and the temperature of the environment. For instance, a body that falls through ice and drowns will lose temperature with extreme rapidity, whereas a body struck by lightning on a hot day will lose heat very slowly.

FIG 11 The proper way to take the pulse *First* place the tips of all four fingers on the bone below the base of the thumb and *then press gently* toward the center of the wrist in the direction indicated by the arrow

Another factor influencing the rate of heat loss is the size and the amount of fat on the body A small baby weighing seven pounds will dissipate its heat much more rapidly than a fat woman who weighs two hundred pounds In spite of these factors *the temperature of a dead body should always be noted by the investigator* Generally it is sufficient to lay the hand upon protected surfaces of the body, such as under the arms and if the body still feels warm that is evidence that death has taken place within the last few hours If the body feels cold and clammy under conditions of average room temperature it is likely that death occurred at least eighteen to twenty four hours previously

Recently extensive experiments have been conducted by Drs Lyle and Cleveland of Cincinnati on the rate at which a dead body loses heat on the basis of average room temperature Tem

peratures were taken of the interior of the brain liver rectum and various other parts of the body in a large series of cases They found that the loss of heat from the brain provided the most reliable index to the length of time since death took place

Their studies indicate one fact of great practical importance If the rectal temperature of an average sized person is the same as room temperature of 72° one can be absolutely certain *that the body has been dead at least twenty four hours* and probably closer to thirty six hours have elapsed since life ceased

Development of Postmortem Lividity—Postmortem lividity is *a purplish discoloration* of the body that occurs on those parts of the body which are nearest the floor This discoloration is caused by the settling of the blood by gravity into those areas During life the blood which comprises about one tenth of a person s total weight is under pressure and circulating After death, the pressure falls to zero and the blood begins to settle by gravity so that no matter what position the body may be in those portions of the body which are lowest will be the areas in which the blood will settle Under most conditions this discoloration will begin to be apparent from one to two hours after death

The observation of lividity is important for two reasons The first is that it gives a general indication as to how long the body has been dead The second is that it sometimes is an indication of whether the body has been moved or disturbed after death When the blood has once settled there is a certain amount of clotting which takes place in the tissues so that if the body is moved after this has taken place lividity will still be present Consequently when a dead body is found with postmortem lividity on the *upper surface of the body* the investigator can be sure that *someone has moved that body* from its position at a time of *least several hours after death occurred* In deaths from carbon monoxide poisoning the lividity will be cherry red instead of the usual blue or purple color Bodies which have suffered wounds so extensive that a large part of the blood has been lost may show little postmortem lividity or none whatever

When postmortem lividity first develops if the end of the finger is pressed firmly against the skin and held for a moment or two it will be noticed that the lividity at that point will disappear and the skin will be white When the pressure is released

the lividity will return. After four or five hours the blood in the tiny skin vessels which causes the discoloration becomes clotted so that finger pressure does not produce the blanching as it did at first.

In Austria I once assisted Prof Breitenecker of Vienna in performing an autopsy upon the body of a very large man At first I was somewhat puzzled because well-defined postmortem lividity covered the entire body except for a blanched area about four inches wide across the man's chest Dr Breitenecker pointed out that the complete coverage of the lividity was due to the body having been moved several hours after death took place. Pressing the finger firmly caused blanching in all areas over the back and lower sides of the body, while over the front of the body it did not This proved that the man had fallen and died with the front of the body down and the large white band surrounded by lividity was caused by his arm being caught underneath the body That was the position in which the body had been found and later placed on a bed on its back Although the deepness of the lividity appeared uniform on all surfaces by this finger pressure technique it was possible to demonstrate on which side lividity had first taken place and the position in which the man died

Development of Rigor Mortis.—Rigor mortis, which is a stiffening of the muscles of the body, is due to chemical changes within the muscle tissue itself. Immediately after death the body is very limp, and the head can be turned easily from side to side, and the arms and legs moved without difficulty into any position. After rigor mortis has become established, the muscles are very rigid and the position of the limbs can be changed only be exerting considerable force. Literally, the body is as stiff as a board and, if picked up by the feet, only the back of the head will be touching the table.

There is considerable disagreement among authorities as to *the length of time required for rigor mortis* to take place under normal conditions Many factors will alter the speed with which it appears and the length of time before it leaves, but the following schedule is substantially correct for the average case.

Rigor mortis develops first in the face and jaws and the onset usually takes place in this area in from three to five hours after death. The rigidity gradually extends downward involving the

Fig 12 A decomposed body Nothing but the skeleton and portions of clothing remain After a study of the teeth and bones the medical examiner estimated the deceased to be about 25 years of age which was later found to be exactly correct Taken in the vicinity of Lansing Michigan on September 21 this person was last seen alive on July 6 Portions of the body were found a considerable distance away where they had been dragged by animals

neck chest and arms abdomen and finally the legs and feet For the entire body to be involved usually requires from about eight to twelve hours after death

The body will remain rigid for a variable length of time but generally from twelve to twenty four hours In certain cases it will last much longer sometimes for as long as two or three days

Rigor mortis then begins to leave the body and it disappears in the same order that it made its onset First the face and neck will again become flaccid and then the other portions of the body will become limp in the same order that the rigidity developed When the rigidity begins to disappear it will usually be entirely gone in from eight to ten hours

Observing the exact extent of rigor mortis may be of great importance in fixing the ***approximate time of death*** For instance if an officer finds a body where postmortem lividity is well developed and rigor mortis is well marked in the thighs and legs but the neck and shoulders are limp he can estimate the time of death as follows

1 Allow eight to twelve hours for the *development* of rigor mortis

2 Allow approximately an additional eighteen hours *while the whole body* is enveloped

3 Allow three or four more hours for *the disappearance of* rigor mortis in the upper half of the body

From the addition of these time estimates, it becomes obvious that death took place in such a case in the neighborhood of twenty-nine to thirty-four hours previously

Factors Influencing Onset and Departure of Rigor Mortis —Estimating the time of death from the extent of rigor mortis is at best only an approximation because many factors influence the speed with which rigor mortis develops Persons dying under conditions of intense emotional excitement may develop rigor mortis very rapidly This is likewise true when death occurs suddenly while one is engaged in strenuous physical activity In feeble, exhausted or emaciated persons the development of rigor mortis is hastened In the heavily muscled athletic type of body, the process is retarded

The influence of temperature of the atmosphere after death may have considerable bearing on the development of rigor mortis Authorities disagree as to the effect of temperature on its development However, it is my experience that if the body is chilled after death rigor mortis will be more rapid in its onset and will be slower in leaving the body than when it remains warm

It is important that the investigator understand that rigor mortis does not affect any two bodies with the same rapidity When deaths have been due to a common cause such as carbon monoxide poisoning it is often desirable to know which of two or more bodies died last If the bodies have not been discovered until several hours after death has occurred it is hazardous to speculate on the order in which death took place from the extent of rigor mortis alone

The officer must *not forget that if a* body has been *embalmed* the rules of rigor mortis cannot be applied Embalming produces a chemical stiffening which is in many ways similar to rigor mortis but *real* rigor mortis does not develop in an embalmed body

Cadaveric Spasm —Under certain conditions a stiffening of the hands or arms may take place immediately at the time of death This is known as cadaveric spasm and is confused with rigor mortis in its general aspects It is not uncommon that a

FIG 13 Cadaveric spasm The gun continues to be gripped tightly after death although the rest of the muscles are limp This proves that the weapon was in the hands of the victim at the time of death It is impossible to place a gun or other weapon in the hands of a dead person and have it gripped tightly as shown here

person who has a firearm or knife in his hand at the time of death will continue to clutch it tenaciously following death *Frequently suicides will still have a gun or razor in their hand* where it is held very tightly although there is no rigor mortis present in other parts of the body The cause of this phenomenon is not known

It is important to observe this however, because when a knife or gun is found tightly grasped in the hand of a dead person, one can be sure that he held it at the time of his death *It is impossible for another person to place a weapon in the hand of a dead person and have it grasped tightly as in the situation referred to*

Development of General Putrefaction—After death has taken place, a body tends to gradually return to the chemical compounds of which it is composed Embalming only retards this process and does not destroy it altogether In the intestinal

tract are enormous quantities of bacteria which break down body tissues so that in a certain sense a corpse contains the elements of its own destruction If the body happens to be lying in the open and is exposed to summer weather conditions the process is rapid In addition to bacterial action under warmer weather conditions insect and animal life combine to destroy it in a short period of time The speed with which this process takes place is influenced by the atmospheric temperature the amount of clothing the size of the body and ground conditions

Recently the writer examined the body of a man who was known to be alive less than nine weeks before The body had been clothed and had been lying on a river bank in weeds during the hot part of the summer In this case no soft tissue of any kind remained not even in the shoes The ligaments holding the spinal column together were entirely gone and each vertebra could be picked up with no attachment to those adjoining The bodies of small babies will decompose even more rapidly and completely because their skeletons are not nearly so well developed *However estimating the date of death from the state of putrefaction is very hazardous*

The early signs of putrefaction are a greenish discoloration of the skin of the abdomen followed by a darkening of all of the skin a thickening of the features and a general bloating of the body Occasionally the darkening of the skin and the bloating renders it difficult to identify the race of the deceased As in the case of rigor mortis there is great variation in the rapidity with which putrefaction develops It has frequently been observed when deaths have been due to the same cause and postmortem conditions have been identical that one body may show little or no signs of putrefaction while another may display advanced changes

Destruction by Insects—Sometimes a knowledge of the species and development of maggots and other insect life will give an indication as to the length of time the body has been exposed Some investigators such as Doctor Meguin of Paris have developed a scale showing the kinds of insect life which in succession attack a decomposing body But from a study of beetles and other insects it is impossible to get more than a

FIG 14 Ad pocere wh ch has developed on a body that had been lying in a s vamp for about two years The head was found about a half m le d tant

rough approximation of when death occurred particularly in a locality where there are extremes in climatic cond tions Finally the body is reduced to dust and this dust is essentially the same as that which is the residue after cremation

In bodies that have been buried the degree of decomposition will vary widely The writer has examined some bodies that have been buried over three years in which the preservation has been excellent and other cases in which putrefaction has been very extensive after only a few weeks Factors which influence de composition after burial are the physical condition of the body the embalming the type of casket and the kind of soil in which it is buried In my experience a thin emaciated body will de compose far more slowly than that of a heavy person A wooden casket with a sawdust mattress will preserve a body much better than a metal one and burial in sandy soil with good drain age is the ideal ground condition for long preservation

UNUSUAL POSTMORTEM CHANGES

Adipocere —Adipocere (ad I po ser) is a greasy soap lil e sub stance which develops when a body has been kept under moist conditions either in water or damp soil It is due to chemical changes involving the fat in the body and develops most rap idly in warm weather Under ideal conditions it may develop in a few weeks in the summer time but generally it takes much longer The material has a rancid smell a greasy feeling and floats in water The entire body may be enveloped and the gen eral form and structure of the body will remain in a natural condition to such an extent that sometimes a wound may be identified after a period of several years The face and buttocks

are the parts of the body most frequently involved, but any part of the body may develop adipocere

Mummification.—This condition is brought about under circumstances exactly opposite to those producing adipocere. If death happens to take place in a hot, dry place where body fluids may be rapidly absorbed, the tissues will become dry and hard. This tends to delay putrefaction so that the form of the body may be preserved for years and even centuries. In most of the inhabited portions of the United States atmospheric conditions are not suitable for mummification and it is rarely seen occurring in its natural state.

EXAMINATION OF STOMACH CONTENTS

A procedure which is of great importance in fixing the time of death is the examination of the stomach contents. If stomach contents are present, it is possible for the pathologist to tell with reasonable accuracy of what the last meal consisted. The stomach will usually be empty in from four to six hours after a meal has been eaten. For instance, if the stomach is found to be well filled with food and digestion of the contents is not extensive, it is fair to assume that death followed shortly after the meal. If the stomach is entirely empty, death probably took place at least four to six hours after the last meal. In addition if the small intestine is also empty, the probability is that death took place twelve or more hours after food was last eaten. The interpretation of the variations between these extremes must be left to the doctor making the examination.

IMPORTANCE OF ASSOCIATED EVENTS

Equally important to that information derived from the body itself is the observation of associated events. Among the most important of these is the fall of rain or snow. For instance in one important murder case a heavy snow started to fall 15 minutes after the dead body was found. Six hours later the automobile of the deceased was found about three miles away. Although about four inches of snow had fallen since the body was found the pavement under the car was dry and an examination of the under surface of the fenders showed that it had not been driven since the snow started to fall. Since the deceased had been seen

FIG 15 Mummification This man hanged himself to the top of a tall pine tree where it was exposed to bright sunlight and wind The skin became hard and dry and was the only structure holding the body together At autopsy the body was almost eight feet long due to stretching

alive in his car only 15 minutes before his body was found this was proof that the automobile had been abandoned almost immediately after the murder

Other factors helpful in *indicating the time of death* are such things as whether or not electric lights are burning whether the milk or newspaper has been removed from the doorstep whether meals have been prepared and eaten dishes washed pets cared *for and the condition of the fire in the furnace* Sometimes when the deceased has suffered an assault or has been struck by a car his watch will be damaged and will stop at the time the injury occurred

When a body *has been found lying in a field* or woods and has

obviously been there for a period of several weeks, helpful information may be derived from an examination of the vegetation underneath the body Are the leaves fully developed? Have blossoms appeared? Such observations give a definite clue as to when the plant life was extinguished A botanist familiar with the vegetation of the vicinity can render valuable assistance in determining when the body was placed there

THE EFFECT OF EMBALMING

The purpose of embalming is to saturate the body with a chemical which will kill bacteria and, at the same time, harden and set the tissues Practically all embalming fluid is a solution of formaldehyde and alcohol This is injected into one of the large arteries by either gravity or positive pressure and, at the same time, the blood is drained out of a vein so that a large part of the blood volume is replaced by formaldehyde solution In addition, an opening is made into the chest and abdominal cavities and an amount of the solution is forced into these cavities This tends to delay the action of putrefactive bacteria and to preserve the appearance of the body for funeral ceremonies

Embalming frequently handicaps and complicates the investigation of the cause of death The determination of some poisons is made impossible after embalming and the discovery of others made difficult In general it is better to conduct a medicolegal examination upon a body before embalming has taken place and, under many circumstances it is absolutely essential that embalming be delayed until after the autopsy

CHAPTER 4

Examination of Blood Stains

> Lady Macbeth,
> "Out, damned spot! out, I say! . . .
> Here's the smell of the blood still,
> all the perfumes of Arabia will not
> sweeten this little hand Oh, oh, oh!"
> Act V: Scene I *Macbeth*, Shakespeare

THE EXAMINATION of stains which are suspected of being blood should be left entirely to the trained laboratory expert. However, it is important to know what can be done and what cannot be done in the way of identification

Blood or Foreign Substance?—At the scene of a homicide, when the investigator finds a stain which he thinks might be blood, the three important questions which confront him are as follows:

1. Was the stain made by blood or by some other substance?
2. If it is blood, is it of animal or human origin?
3. If made by human blood, to which of the four groups of human blood does it belong?

The first question to be considered by the officer when he observes a stain on clothing or on any other material is whether or not it is actually blood. Many substances, such as coffee stains, chocolate, paint, rust, tobacco, to mention just a few, resemble dried blood. When these are brought to the laboratory, it is possible to tell in just a few minutes whether or not the stain is blood or some foreign substance Blood stains are extremely resistant to washing by water and, if a stain is made by blood, even though the garment may be washed several times, it is possible for the laboratory man to determine that it was originally caused by blood.

Dried blood on a dead body or article is very resistant to water. Consequently if a person has been killed in such a manner

that the blood has been allowed to dry on the hair, skin or clothes the dried blood will remain intact for a surprisingly long time *even though the body has been totally submerged* In a test that was made in connection with a recent murder case spots of fresh blood about the size of a silver dollar were placed on a number of small pine blocks These were exposed to the air at room temperature for various lengths of time and then were sub merged in sea water for seventy two hours Up to a period of twenty minutes drying before submersion there was little or no visible evidence of blood remaining, but from twenty minutes onward the evidence of blood was distinct and spots which had dried for two hours or more showed practically no indication of the washing and looked as they did before the submersion

Examination of Blood Stains—Fortunately laboratory tests for blood stains are very sensitive It is often possible to identify blood where no visible evidence of it remains If a murderer had blood on his hands, although they were carefully washed it should be possible to get a positive test from the hands for a considerable time afterwards Even after three or four days, de pending upon how thoroughly and frequently they had been cleaned, the hands may reveal the presence of blood If blood has been smeared on the floor or furniture and then wiped off, a test made directly on the floor or article may show its presence

Although dried blood stains are very hard to remove, ***blood does not adhere readily to swiftly moving metallic objects*** For instance, it is very difficult and often impossible to detect blood on a bullet which has passed through a body Razors and sharp knives which have made a deep gash in a body may show little or no evidence of blood

In northern Michigan a woman was fishing in a row boat in the middle of a lake when a plane flew low over the lake and a propeller cut her body nearly in half A careful examination of the propellers the following day failed to disclose evidence of blood on any of the blades

There are several laboratory procedures by which it is possible to identify blood However, they are highly technical and should be attempted only by a trained expert in a well equipped laboratory Some organizations train their officers to conduct these tests at the scene of the crime *Not only is this unneces-*

sary, but it is courting disaster The greatest service that the coroner or investigator can render is to appreciate what can and cannot be told from suspicious stains He then should take pains to get the material into the hands of the expert in such condition that it is possible for him to conduct an accurate test and there by obtain evidence that will hold up in court

Human or Animal Blood?— After having determined that the stain is blood, the next question is whether or not it is *human blood* This involves a much more complicated laboratory pro cedure but, if there is an adequate amount of the blood speci men, it is possible to tell whether it is human blood or that of some animal This is accomplished by means of the *precipitin test*, a highly complicated examination

Blood Group —If the specimen is found to be human blood it is important to determine if possible to what blood group it belongs The blood of every human being belongs to one of four blood groups which are known as groups "O,' "A,' "B," and "AB " For instance, a piece of blood stained clothing may be found and it is suspected that it belongs to a certain individual who may be under arrest If the group to which the blood stain belongs is not the group to which the suspected individual be longs, it is definite proof that it could not have been that sus pect's blood that made the stain

During the last few years numerous sub groups of these four main groups have been discovered The trained blood expert can now identify more than three hundred separate kinds of human blood This serves to greatly increase the usefulness of blood examination as a means of positive identification How ever, this is a very delicate scientific procedure and compara tively few laboratories have trained personnel and equipment to identify all of these distinct sub groups

To run a blood grouping test it is necessary to have more than simply a small spot of blood The more blood that can be collected the better and if possible, it is well to have some ac tual clots of the blood to make this determination Care must be used in interpreting the results of blood grouping examina tions The mere fact that the blood of a suspect and the blood found in a stain belong to the same group is not proof that the blood stain came from the suspected individual With the

whole population of the world divided among four groups, it is obvious that there are millions of persons belonging to each group and in the case of one group, namely, "O," nearly one half of the entire population of the world belongs to this particular category

Blood Grouping from other Body Fluids —In most people the same substance which makes it possible to distinguish one blood group from another is also present in other body fluids, such as urine, saliva, and perspiration If a situation arises when it is impossible to obtain a specimen of blood for grouping purposes it is sometimes possible to obtain samples of these other fluids which may be typed In one important case it was possible to obtain an accurate typing from the perspiration shields which were removed from the victim's clothes Some investigators claim that it is even possible to obtain a typing from a cigarette butt The possibility of utilizing the dried remains of these other body fluids should never be overlooked particularly in cases where any possibility of typing the blood has been destroyed by embalming

THE METHOD OF PRESERVING AND REMOVING BLOOD SPECIMENS TO THE LABORATORY

The cardinal rule in dealing with spots which are suspected of being blood is to remove the article itself with the spot intact to the laboratory *Under no circumstances scrape such spots off with a knife* except as a last resort and even then it is hardly worth doing If the stains are on an automobile headlight or bumper, remove that equipment from the car and take it to the laboratory without touching the stain If the spot is on a piece of woodwork or flooring, use a wood chisel and cut the material out with the blood stain on it If the article happens to be on something which cannot be removed, then have the laboratory technician come to the scene of the crime and make his own extraction Where stains are scraped off with a knife, there is always so much dirt, paint and general debris mixed in with the blood specimen that it ruins any accurate determination that can be made on it Where there are blood stains on

FIG 16 *In the large pool of blood appear tracks of bare feet At the left* can be seen a clear space where the body has been dragged away After a few hours, it is difficult to estimate with accuracy how long the blood has been there

clothing, do not attempt to cut out the individual stains to take to the laboratory, but take the entire garment The same applies to cushions or any article that can be moved without too much inconvenience In searching for blood stains in an automobile, the upholstering should not only be examined carefully, but the pedals running boards etc should never be overlooked If the car is suspected of having struck a person never fail to put it on a hoist and examine the bottom carefully It can then be noted whether the car has run over some one and sometimes blood will be found on the bottom of the axles, the oil pan and other places where it would not be noted in a casual inspection

The cardinal rule in preserving blood stains is *"keep them dry"* If this is done blood typing and other tests may be performed for an almost infinite period of time If the stains are allowed to become moist bacterial contamination takes place rapidly and renders the stain useless for blood grouping examinations

HOW LONG DID THE VICTIM SURVIVE THE ATTACK?

The quantity of blood present around a dead body may give considerable indication as to how long life existed after the assault When a person is dead, the blood pressure naturally falls to zero and bleeding ceases *In other words dead bodies don't bleed* The only exception to this is where there is a large wound in such a position on the body that there will be drainage due to gravity This seepage is a mixture of blood, serum and frequently other materials It is generally quite dark in color and may accumulate in considerable quantity if the wound is large and ragged If a body is found in which there has been a large pool of blood which collected from comparatively small wounds, it indicates that that person lived for a considerable length of time after the attack and in many cases the actual cause of death is simply loss of blood A body has a defense mechanism against excessive bleeding in that as soon as bleeding starts in any considerable quantity the blood pressure is automatically dropped, and this consequently slows the rate of bleeding

A short while ago there was a case in which a young woman was found dead with a gash about one half inch long on the back of her scalp She had also been shot in the head by a 22 calibre bullet From this wound on the back of her scalp there had accumulated a pool of blood about three feet across and it would have been larger had it not drained through a crack in the floor Assuming that the bullet wound and the gash in the back of the head were both made at the same time, it is evident that she must have lived for a considerable period of time, possibly an hour or two for all of that blood to have flowed from the small scalp wound Considered with other evidence it was very strong evidence that death was suicidal although a man was nearly convicted of murdering her In cases where death follows immediately from such sudden causes as a gunshot wound through the heart, there is usually very little blood on or around the body

Estimating Age of Blood Stains—The next question which confronts the investigator is *How long has the blood been*

there? This is determined by *the amount of coagulation, drying* and change in color which has taken place Even though the officer may not know how to interpret the significance of these changes, it is important that he shall observe accurately and note down the exact condition of the blood with respect to the following points

1 Is it bright red, or is it brown or black?

2 Is the blood still moist? Is it dry around the edges, or is it entirely dry?

3 If the blood is still liquid, will a pencil which is drawn through it leave a mark or will the blood cover up the track of the pencil as it is drawn through?

Blood from the *arteries* is bright red Blood from the *veins* is considerably darker in color However due to the fact that the blood pressure is so much greater in the arteries than in the veins, if there is a wound of any size it is largely the bright red arterial blood which leaks out If there is enough of it to make a small puddle, then after three to five minutes the blood will begin to clot and after the clot is formed it becomes solid to such an extent that a stick or pencil drawn through it will leave a definite mark in it As it continues to dry, it gets darker in color until, at the time it is completely dry it will have a dark brown appearance Beyond that the color will not change very much In some cases an old dried blood clot will have become so dark as to be almost black A single drop of blood that falls on a dry surface, such as a table or wood floor will dry completely in about an hour at room temperature Where it is collected in pools, it may be several hours before it is dry depending upon the size and depth of the pool formed After a matter of a few hours and after the blood has become completely dry it is *very difficult to tell from the blood stains how* long they have been there, because changes in them from that point on take place very slowly In general however the older that blood stains are, the blacker they become

When small drops of blood strike a surface at an angle it may be important to know from what direction the blood came When the blood strikes a smooth surface, it will be noticed that

it often leaves a large blot with one or two smaller ones trailing off in a straight line This condition is caused by the blood coming from the direction of the large to the small blots In other words the largest blot is made first and then the smaller ones afterwards

CHAPTER 5

Identification of Dead Bodies

IDENTIFICATION of either living persons or dead bodies is treacherous It is a common occurrence that persons suspected of serious crimes are wrongfully convicted on false identification, usually made under circumstances when the chances for careful observation were inadequate Sometimes identifications are malicious If one stops to realize that among his own acquaintances there are usually several persons whom it is difficult to distinguish from one another, he can see what are the possibilities for error in identifying a stranger days or weeks after a crime was committed

In my own experience I recall an occasion when there was a disastrous fire in a building in which a friend of mine was living At the time I was on duty in the hospital where the victims were being received Among them I instantly recognized the dead body of my friend The body had not been injured or deformed in any way and I would have had no hesitancy whatever in testifying under oath about the identity of this body A day or so later I was astounded to meet him on the street and learn that he had not been in the fire at all

Even such accurate methods of identification as the use of fingerprints are not without sources of error Many diverse methods of identification have either been employed or suggested as a means of making identification more accurate Some of these are the *Bertillon* system (which is a means of identification based on accurate physical measurements), a universal file of dental charts, photographs of the back of the eyeball showing the pattern of arteries and veins in the retina, and the utilization of blood groups and the numerous sub groups

APPEARANCE OF DEAD BODY

After death occurs the problems of identification are greatly increased due to changes in the appearance of the body caused

by putrefaction Under ordinary conditions changes in appearance due to decomposition are apparent in about 24 hours Starting with a greenish discoloration of the abdomen, the face and other parts of the body begin to show a brownish discoloration, and within a few days the surface of the body may become practically black At the same time gas is formed in the tissues, swelling takes place, the face becomes broadened, the lips thick, the lines of the face are obliterated and the features indistinct Sometimes it is difficult to determine whether the body is that of a white person or some other race

The rate at which these putrefactive changes take place is by no means uniform For example, two persons were overcome by carbon monoxide gas in the same room and must have died at approximately the same time Their bodies were discovered about 36 hours later One showed no skin discoloration or other evidence of putrefactive changes while the other body was badly swollen and almost black

A dead body may be found 24 or 48 hours after death showing little or no evidence of decomposition However, when the body is disturbed or moved to a morgue the putrefactive changes may take place with amazing rapidity

Do not over estimate weight of a decomposed body The bloated appearance generally leads one to estimate the weight to be far above what it actually is

IDENTIFICATION OF WHOLE BODIES

When all parts of the body are intact except for possible putrefactive changes much information of value is readily at hand The height and general build of the person is apparent—determination of sex offers little difficulty Clothing, jewelry, keys or any personal articles carried by the deceased offer much help The teeth, scars, tattooing deformities—all may supply important information

Fingerprints and Markings on the Hands —On any unidentified body fingerprints should be taken if the hands are in such condition that diagnostic prints can be obtained In the case of a body which has been under water for a day or longer, or has been exposed to excessive dryness this may be very difficult However, various methods have been devised for obtaining

satisfactory prints from the fingers under such circumstances In some cases it is advisable to dissect off the skin from the finger tips and then by placing this skin over the fingertips of the operator, satisfactory prints may be rolled Sometimes liquid paraffin can be injected under the skin to smooth out the surface. Various solutions have been developed for softening and smoothing dry, shriveled finger tips. Gerber has pointed out that when a body has been immersed in water for such a long time that the outer layer of skin has disappeared entirely, satisfactory prints can be obtained from the under layer of the skin Nebergall has obtained satisfactory fingerprints by the use of soft x-ray technique on the skin after it has been removed from the fingers.

In addition to the fingerprints, the hands frequently exhibit calluses, scars, or deformities of the fingers which are peculiar to certain occupations. Ronchese* has written a valuable guide for interpreting the significance of these marks If not badly decomposed the finger nails should be carefully examined, as their care may give some indication of economic status The presence of dirt, oil, grease, chemical stains etc may likewise be of importance

Teeth.—The significance of the teeth in identification problems has never been fully appreciated although during the last hundred years several notorious murders have been solved by means of dental examination. The teeth give evidence as to the age of the individual, his general facial characteristics, his economic status, sometimes his occupation and not infrequently positive identification of the individual himself

When a situation arises where it appears that a dental examination may be significant the investigator should employ the services of a trained dentist. He in turn will frequently require x-ray examination of the teeth, jaws and face.

Until the age of about twenty-five years an examination of the teeth alone gives a rather accurate index of the age of the individual.

The first set of teeth number ten in each jaw and are known

* Ronchese, Francesco *Occupational Marks* New York, Grune and Stratton 1948

FIG 17 Identification by lip prints A woman was struck by an automobile striking her face on the left front fender of the car shown above

variously as baby teeth, milk teeth or deciduous teeth These push through the gums at about the following ages

Central incisors	7 months
Lateral incisors	9 months
First molars and canines	12 to 16 months
Second molars	2 years

The loss of the deciduous teeth and the appearance of the permanent teeth is a gradual process and starts with the eruption of the first permanent molars at the age of six years A schedule of the appearance of the permanent teeth is as follows

First molars	6 years
Central incisors	7 years
Lateral incisors	8 years
First bicuspids	9 years

Second bicuspids	10 years
Canines	11 years
Second molars	11 to 12 years
Third molars or wisdom teeth	17 years or any time following

The roots of the third molars will be completely formed by the age of 25 years It is necessary to have an x ray examination to make this determination In middle life and old age it is possible to estimate the age only in a general way from an examination of the teeth alone In general the older a person becomes the more his teeth show evidence of wear, dental repair, and gum recession In an old individual with all the teeth missing the lower jaw becomes thinner with a resultant flattening of the

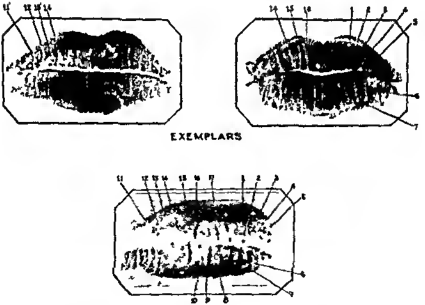

FIG 18 Comparison of lip-prints The normal lines and fissures of the lips are an individual characteristic much the same as finger ridges A lip print was removed from the left front fender of the car in the preceding photograph and compared with those of the injured woman This proved beyond question that the car in Fig 17 was the vehicle which had caused the injury (Figs 17 and 18 Courtesy of Leland V Jones, Los Angeles)

lower part of the face The bone may likewise be thinned out or destroyed in localized spots due to pyorrhea and evidences of this disease may remain long after the teeth are all gone or the disease disappeared

Determination of Facial Characteristics—An examination of the teeth and jaws may give a valuable clue as to the general conformation of the face Van Leeuwen has pointed out that if a crown of an upper central incisor of the deceased is available we may obtain some knowledge as to facial contour, height of the individual, and perhaps type of build from it By inverting the tooth and allowing the biting edge of the crown to correspond to the hair line of the individual and then looking at the front surface we can roughly determine the shape of the face These face shapes fall in three classifications—square, tapering and ovoid In carrying this further the long thin, square crown would indicate a face tapering markedly in the region of the chin An ovoid crown would signify a round faced individual These rules are not infallible but the resemblance is striking enough in most cases to be more than just coincidence

The relative position of the lower jaw to the upper jaw may likewise give valuable information as to facial characteristics With the jaws shut, the lower front teeth normally fit inside the upper front teeth and are in direct contact with them In some individuals the lower teeth protrude beyond the upper incisors and the condition is known as *over-bite* It results in the lower jaw and chin being excessively and noticeably prominent The opposite condition from this is known as *over-jet* and is due to the lower incisors failing to meet the upper front teeth by a distance which may range from $\frac{1}{4}$ to $\frac{1}{2}$ of an inch or more Consequently, these individuals display over prominence of the upper jaw accompanied by under prominence of the lower jaw and a small and receding chin If the two jaws are still intact even though all soft tissue may have disappeared, if present these characteristics may be determined easily

Determination of Economic Status—The condition of the teeth and the type of dental repair give a significant indication of the economic and social status of the deceased Such conditions as unfilled cavities, missing teeth which have not been re

placed old roots still present usually indicate that the deceased was an individual of low economic status On the contrary, gold inlays, bridges, well made dentures indicate that the deceased not only had the intelligence to seek good dental treatment but the means to pay for it The finding of both amalgam fillings and gold inlays is an indication that probably more than one dentist has done the work

If an examination reveals good dental work it is more than likely that the dentist who did the work has a complete dental chart of the individual on file If that is the case a complete and accurate identification of the individual may often be made When one considers that a full complement of teeth is 32 that each tooth has five surfaces with various fissures and grooves that the arrangement of the teeth in the jaws the mode of occlusion and the arch of the palate are different in each individual, it becomes apparent that no two sets of teeth are exactly alike In addition to this there may be absence of one or more teeth, fillings, inlays crowns or dentures which add to the reliability of the dental identification

In case one or more teeth may be missing a dental or oral surgeon can determine whether it was removed before death, was knocked out by a blow or was removed or fell out after death This is accomplished by examination of the tooth socket and x ray of the jaw If the tooth was knocked out at about the time of death or was lost postmortem the bony socket will show rough, jagged edges which usually are not present if the tooth was removed by a dentist at some time prior to death Should the tooth have been knocked out sometime previous to death growth of new bone around the socket will smooth the edges An x ray examination of an empty tooth socket will give a rather accurate index as to how long before death the tooth was removed If a tooth had been extracted a year or more before death an x ray will show the socket to be completely filled with new bone An extraction six months before death would show the socket filled with new bone with the outline of the location of the roots still present For lesser periods of time the picture will be similar except that less bone will have filled the socket Two or three weeks after an extraction the gum is completely

healed but there is no bone formation in the socket From one day up to two or three weeks the socket shows blood clots with various stages of healing of the socket edge

Other Medical Characteristics—If a body has not been dead long enough for decomposition to set in it is very important to obtain a sample of blood Not only is this necessary for reasons that pertain to medicolegal autopsys generally but it may likewise give a lead to the identification Blood should be typed to compare with records which may later become available Also a Kahn test for syphilis should be performed A microscopic examination of a blood smear may also disclose other disease conditions which may be important in the identification

The unidentified body should be carefully checked for amputations body deformities enlarged joints of the fingers due to arthritis immovable joints due to disease and such conditions as bowed legs and curvature of the spine X rays will show the presence of healed fractures metal pins plates or screws which may have been used in treating serious fractures Occasionally an x ray will reveal bullets or other foreign bodies which may have become embedded at some previous date

Finally it is important that a careful autopsy be conducted to determine whether or not any organs have been removed Those most commonly found missing are the tonsils appendix gall bladder kidney the prostate the uterus and ovaries Likewise watch carefully for surgical scars which may indicate hernia repair circumcision or an operation upon the thyroid gland Women who have borne children will frequently have numerous parallel scars on the skin of the abdomen This condition may also be found in obese persons both male and female and is caused by over stretching of the skin

Careful attention should also be paid to moles birthmarks scars on the face due to smallpox and other permanent skin blemishes or body distortions such as cauliflower ears broken noses saber scars or tattooing

Tattoo marks are made by depositing pigment in the under layers of the skin Over a period of years they gradually tend to fade This is due to the fact that the pigment is absorbed and deposited in the lymph glands which drain that particular area The most common region is in the glands located in the armpit

where the pigment remains permanently Consequently, a tattooed arm may be completely destroyed by fire or other means or the tattoo removed by surgery and yet careful examination of the glands in the armpit will disclose the fact that the deceased had been tattooed Some police departments have set up files on tattoo marks for the purpose of helping to establish identication of both living persons and dead bodies

Examination of the Hair and Eyes—If not too badly decomposed a careful examination of the eyes will reveal their color the presence of an artificial eye or various diseases such as cataracts or operations which may have been performed on the eyeball If glasses belonging to the deceased are found it is vitally important that they be carefully preserved for an examination by an optical expert The formula of the lenses may be obtained and often the manufacturer of the frames This information has been of vital importance in many cases

Hair—The hair should be carefully examined and note taken of its color, length texture curl and whether or not it has been dyed or bleached More extensive information on the examination of hair is given in Chapter 16

Clothing—It hardly seems necessary to mention the necessity of painstaking examination of the clothes and personal articles found on an unidentified body The type of clothing—whether it is expensive cheap or some sort of uniform helps to indicate the social status of the individual Trade marks on suits, laundry marks identification tags jewelry, pictures—all may be identifying clues It is wise to examine clothing under ultraviolet light which may bring out obscured laundry marks or other bits of important information

IDENTIFICATION BASED ON PORTIONS OF A BODY

The principal conditions under which it is necessary to base identification upon a portion of a body involves bodies long dead, remains which have been badly burned, and murders with dismemberment Occasionally it is necessary to retain the services of the department of anatomy of a medical school or an anthropologist with training and experience in this type of work In general the amount of accurate information which may be

derived from the examination of a portion of a body is in proportion to the number of parts of the body which are available for study.

If there are soft tissues remaining such as in the case of a body which has been partially consumed by fire, then all the details previously mentioned in this chapter should be utilized to bring about an identification Frequently however, the only material available consists of portions of the skeleton and the remainder of this chapter is confined to information which may be derived from study of the bones

Primarily we are concerned with three questions:

1. *What was the sex of the individual?*
2. *What was the age at the time of death?*
3. *What was the height?*

If it appears to be important to determine the race or nationality, that becomes a matter outside the scope of anyone except an anthropologist Most good universities have a department of anthropology with members on the staff experienced in this type of work If an occasion arises where it is necessary to make an identification from bones alone the investigator should utilize the services of such an institution if at all practical Consequently, the following remarks are intended to outline only in a general way the scope of what can be done and it is not intended as a guide for persons inexperienced in this field to attempt to make such identifications by themselves

Determination of Sex from Bones.—In general, male skeletons are larger and the surface of the bones rougher than those of the female The long bones of the arms and legs on an average are 8 per cent longer in the male than in the female Krogman has pointed out that in the determination of sex on a complete skeleton accurate results may be obtained by a trained person in practically all cases, on the pelvis alone, 95 per cent, skull

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FIG 19 (Top) A man was struck by a hit skip automobile and the palm of his hand was gouged as shown above (greatly enlarged)

FIG 20 (Center) A car which was suspected of having caused the injury was inspected and under a piece of chrome stripping was found the fragment of the skin shown above

FIG 21 (Bottom) Fig 20 is here superimposed on Fig 19 Notice how the pore ridges and the other fissures of the skin line up perfectly, clearly proving that the car in question was responsible for the injury (Figs 19, 20 and 21. Courtesy of Leland V Jones, Los Angeles)

alone, 92 *per cent* on both pelvis and skull, 98 per cent, and in the long bones alone about 80 per cent accuracy

Sex Difference in Skulls—Perhaps the most common portion of a skeleton which is available for examination is the skull Relatively speaking male skulls are large and the forehead tends to be more sloping The bony ridges above the eyes are prominent whereas in the female skull they are relatively small or absent entirely The eye sockets in the male skull tend to be square as against being round in the female—the chin tends to be flat while in the female more pointed In the male skull the mastoid process is larger and all the points of attachment of the neck muscles are larger and rougher

Sex Differences in Pelves—The pelvis reveals more accurate information about the sex of the individual than any other portion of the skeleton It may be a reliable index of sex even in a child who has not yet attained the age of puberty

The female pelvis was designed for child bearing and in general the shape is broader and flatter than in the male One of the most characteristic differences is in the angle made by the under surface of the pubic bones which join together at the front of the pelvis In the male pelvis this angle made by the two pubic bones is less than 70 degrees while in the female it is greater than 70 degrees and often more than 90 degrees The cavity of the pelvis is relatively narrow and deep in the male whereas in the female, as it has to provide for the birth of a child through it, the cavity is wide and shallow The socket joint in the male pelvis averages about 52 mm in diameter and faces directly sideways In the female the diameter averages about 46 mm and faces somewhat forward as well as outward There are other less defined points of demarcation and as in the case of the skull, all places on the pelvis for muscle attachments are larger and more prominent in the male

Sex Differences in Long Bones—An examination of the long bones of the arms and legs offers less reliable information than is found on the skull and pelvis However, in general male long bones are about 8 per cent longer, heavier and stronger,—the joint surfaces tend to be larger and the various ridges and prominences for muscle attachments are rougher and more sharply defined

DETERMINATION OF AGE FROM BONES

In addition to the information derived from the teeth, other bones of the body give a rather reliable index as to the age of the individual In early life the bones develop from small areas which are known as *ossification centers* From these centers calcium and other minerals are deposited to form the bone Many of these centers start producing bone during the early months of pregnancy while others do not completely finish producing bone until about the age of 25 years Consequently, by x ray examination of various bones of a young person it is possible to tell quite accurately just how old he may be

For instance the bone of the upper arm develops from seven different centers At birth the bone is cartilaginous The first of these centers is seen by x ray in the first two or three months after birth Some of the other centers do not appear until ten or twelve years of age but the bone is not completely formed until about the age of twenty The same general picture holds true for other bones so that it is possible up to the age of about 25 years to determine the age with considerable accuracy

The skull is composed of several flat curved bones which are joined together along irregular lines which are known as *sutures* At about the age of 22 years some of these sutures begin to be filled up with bone and close The process continues throughout life and follows an orderly pattern By means of this fact an expert can examine the skull and determine with reasonable accuracy how old the person is between the ages of 22 and 80

If it is possible to examine the pelvis, an examination of the surface where the two pubic bones unite in front gives much useful information For instance a wavy appearance of the joint surface indicates an age of about 20 years About five years later the waves become less distinct and small nodules of bone appear From about 30 to 35 the surface is smooth and the borders are sharp,—the surface becomes nodular at about 40 and the edges of the bone begin to become rough at about 45 The nodules become more marked—the borders more pitted and irregular as age increases

Beyond the age of 50 years calcification begins to take place in the cartilages of the larynx and ribs which in only a general way indicate the age of the individual If enough bones of the

skeleton are available for study a reasonably accurate estimate of the age may be obtained

ESTIMATION OF HEIGHT

In attempting to determine the height of a body there are a few simple rules which give a general indication of stature For *instance the height of the head measured by the vertical distance* from the top of the head to the tip of the chin is about one seventh of the total height The distance between the finger tips of the out stretched arms is also approximately the same as the height If the skeleton is that of an adult male the point on the front of the hip bone represents the mid point of the entire length of the body

Much more reliable information may be obtained by accurate measurements of the long bones of the arms and legs Several different formulas have been devised for estimating the stature from the length of one or more of these long bones From these Muehlberger has devised a simplified table based on Krogman s* observations which is shown here While there is some slight variation in different races in general the height can be determined within an inch of accuracy by the use of this method Do not attempt to take measurements at the scene where the body is found lying but wait until the bones are thoroughly dry and accurate measurements can be made in a laboratory

DETERMINATION OF CAUSE OF DEATH FROM BONES

Occasionally months or years after a murder has been committed the bones will give important evidence as to the cause of death For instance if a person has died as the result of one of the metallic poisons such as arsenic or mercury the poison can be extracted from the bones years later

The skull is most likely to give important evidence of direct violence When a bullet penetrates the skull a crater like defect is produced—the hole caused by the entrance being considerably smaller than that of emergence from the bone On entering the

* Krogman Wilton M *The Human Skeleton in Legal Medicine* Medicolegal Problems (Series Two) Philadelphia J B Lippincott Company 1949

ESTIMATION OF STATURE FROM LONG BONES OF SKELETON

FEMUR mm	TIBIA mm	STATURE inches	HUMERUS mm	RADIUS mm
277 0	221 0	55	209 5	137 0
292 5	234 0	56	219 0	152 5
308 0	247 0	57	228 0	161 0
323 5	259 5	58	237 0	169 5
339 0	272 5	59	246 5	178 5
354 0	286 0	60	256 0	187 0
369 0	298 0	61	265 0	195 0
384 0	311 0	62	274 0	204 0
400 0	324 0	63	283 5	212 0
415 0	337 5	64	292 5	221 0
430 0	350 0	65	302 0	229 0
446 0	362 5	66	311 0	237 0
461 5	375 5	67	320 5	246 5
477 0	388 0	68	330 0	255 0
492 5	401 0	69	339 5	263 5
508 0	414 0	0	349 0	272 0
523 0	426 0	71	358 0	280 0
539 0	439 0	2	367 5	288 5
554 0	451 5	3	377 0	297 0
569 5	464 0	74	386 0	305 5
585 0	478 5	75	395 5	314 0
15 4 mm ~1"	12 0 mm ~1"		9 3 mm ~1"	8 5 mm 1"

bone on the opposite side of the head the inner surface of the skull will show a smaller defect than the outer table

I recall an instance when an Italian fruit peddler was found dead with his throat cut and consequently his death had been attributed to suicide Many years later an investigation was conducted in connection with an entirely different crime One of the witnesses questioned in connection with this crime dropped a remark that *the old Italian had been killed by being struck* on the head with a hammer and that his throat had been cut after death

Over 12 years after burial the body was disinterred and I examined it The skull was entirely intact except on its upper surface where there was a round punched out hole about $1\frac{1}{4}$ inches in diameter and was exactly the type of a defect which would be expected if death were due to a hammer blow This finding when coupled with other evidence led to the arrest and conviction of the murderer

IDENTIFICATION IN DISASTERS

Disasters strike without warning No one can perceive when they will come—whether they will be in the form of a railroad wreck, sinking of a ship, collapse of a large building, or what unusual form they may take The only certainty is that it will be accompanied by terror, grief, and, for awhile at least, utter confusion Fire and police organizations usually have carefully prepared plans to follow in such an event, but in few cases has there been any preparation given on how to cope with large numbers of dead bodies The efficiency and thoroughness with which the identification procedure is carried out is generally in proportion to the amount of planning and preparations made before the disaster occurs

There are few cities in this country which have facilities for caring for as many as even forty dead bodies which might be brought in within the space of an hour In smaller communities confusion may be increased by bodies being removed to scattered undertaking establishments Thus it is important that preparations be made in advance for using garages warehouses armories or other suitable buildings for the purpose of receiving dead bodies It may be necessary to use power shovels, bulldozers and other such equipment for removing debris to recover the dead Thought should be given to the possibility of having to engage a corps of embalmers to prepare a large number of bodies for burial

Catastrophe identification cards should be prepared and printed Large sacks made of waterproof paper for transporting remains which have been badly burned and smaller bags of the same material but bearing the same serial number for keys, jewelry and other articles which may lead to identification should be on hand

It is of the utmost importance that the task of removing the dead bodies and their subsequent identification should be left entirely to a few well trained persons who are working under the personal direction of the coroner or whatever official is properly in charge The area should be roped off and all others excluded

Interviewing the Relatives—If a large number of dead bodies are laid out on the floor of a temporary morgue do not allow relatives to start walking through trying to identify the de

ceased First classify and segregate the bodies as far as possible according to sex, age, size, clothing, jewelry and individual characteristics The relatives should then give a complete description of the missing person covering all of these points Also determine the past medical history covering such subjects as amputations fractures, operations, heart disease, tuberculosis or any other illness of importance If one or more bodies have been recovered which would tally with the description given, then arrange to show the bodies one at a time to the relatives in a private room but do not subject them to the horrible task of trying to pick out the deceased from a large number If the features and clothing have been destroyed to such an extent as to be unrecognizable there is no point in subjecting the relatives to the ordeal of viewing the remains

Dr S R Gerber, Coroner of Cuyahoga County, Cleveland Ohio, has done some remarkably good work in the field of identification following several serious disasters He has prepared a general outline of procedure and some remarks on problems of disaster identification which are as follows

OUTLINE FOR DISASTER PROCEDURE IN RECOVERY AND IDENTIFICATION OF THE DEAD

Procedure at the Scene —

Avoid undue haste

Organize recovery work and proceed methodically with a *few* trained persons

Area should be roped off and guarded Only trained persons should be permitted on scene

In case of explosion, when parts of bodies may be scattered, before proceeding a study should be made of the force and design of the explosion to determine what location and area should be searched for bodies A designated area should be searched carefully and the remains from the area wrapped in some manner to keep separated from any others and marked at the scene with a water proof tag bearing the information as to the exact location of recovery, the property found with the remains and the name of the recovery crew

Severely injured persons should be accompanied

CUYAHOGA COUNTY MORGUE Nº 1608

CATASTROPHE IDENTIFICATION CARD Case No

1 Name 2 Address

3 Identified by

4 Sex Male Female 5 Color

6 Adult Youth Child Infant 7 Apparent Age 8 Color of Hair

9 Color of Eyes 10 Teeth Good Fair Poor None Dentures 11 Beard Mustache

12 Approx Height in 13 Approx Weight lbs 14 Actual Height in

15 Actual Weight lbs 16 Religion if known

17 Body found at Hospital Dwelling Apt Factory

18 Where did Injury Death Occur 19 Date of Injury Death

20 Time of Injury Death A M P M 21 Give brief history of case

DISASTER SUPERVISOR

THE ABOVE INFORMATION TO BE FILLED IN BY POLICE OR MEN IN CHARGE OF CONVEYANCE (EXCEPT ITEMS 10 14 AND 15)

FURTHER IDENTIFICATION AT COUNTY MORGUE

49 Body Viewed by 50 Date 51 Time Viewed A M P M

52 Description of all Identifying Marks on Body

53 Were Fingerprints Taken 54 Was Photograph Taken

DESCRIBE PROPERTY OR VALUABLES IN THIS SPACE

DESCRIBE CLOTHING IN THIS SPACE

This Tag To Be Tied On Leg Or Arm If Possible.

THE ABOVE INFORMATION TO BE FILLED IN BY CORONER OR DEPUTIES

DO NOT DESTROY—TO BE FILED WITH PERMANENT RECORD

FIG 22 The front and back of a catastrophe identification card

22 Body Brought to Morgue by Police Private Conveyance

23 Names of Officers or Persons with Body 1 2

24 Body Received by Custodian 25 Date & Time Received A M P M

26 Body Undressed by 27 Date Undressed 28 Time Undressed A M P M

29 Were there any valuables on the body? Check (Yes) (No) Describe same on reverse side of tag

30 Was there clothing on the body? Check (Yes) (No) Describe same on reverse side of tag

31 Body Identified by

32 Relationship If Any 33 Address of Person Identifying Body

THE ABOVE INFORMATION TO BE FILLED IN BY

34 Date Identified 35 Time Identified A M P M

36 Body Embalmed By 37 Date Embalmed

38 Time Embalmed A M P M 39 Body Released by

40 Body Released to 41 Date 42 Time Released A M P M

43 On Order From 44 Body Temporarily Interred by 45 Location

46 Date Interred 47 Time Interred A M P M

48 Clothing Received by

EMPLOYEES OF CUYAHOGA COUNTY MORGUE

Fig 23 The inside pages of the same card This is attached to the arm or leg of the victim at the spot where the body is found (Courtesy of Dr S R Gerber, Cleveland)

with similar information which the hospital should record

Conveying the Remains to the Morgue —Those conveying the remains to the morgue should be instructed to wait until the attendants there shall have time to properly enter the information concerning the admission and by whom it was conveyed to the morgue The conveyor should read and verify the entry with his signature Similar procedure should be followed when conveying injured to the hospitals

Where there is an established morgue the procedures should follow as closely as possible the usual routine on admissions in so far as the records are concerned

Where there is no established morgue one location should be designated as such and the personnel should be thoroughly instructed as to procedures before any admissions are accepted Every coroner should have the foresight to plan for such emergencies and have a disaster corps instructed It must be remembered that any advantages gained by unorganized haste will be overshadowed by the grief caused by confusion

Procedure at the Morgue —

Admission —Admission (as previously described) Assign consecutive casualty numbers to provide progressive tally

Viewing of Remains —Detailed description of the remains themselves,

- Does this represent a human body?
- What parts of the body are presented?
- Can sex, color and age be determined?
- Any evidence of previous operation? Anatomical deformities, and dental record?
- Detailed description of any individual peculiarities Tattoo, etc
- Detailed description of injuries sustained from disaster
- Detailed description of clothing, jewelry or any property with the body (The body should be unclothed in the presence of the viewer All property

and clothing should be left with the body for a reasonable length of time and the person making the identification should be shown the property only *after* making a description of same)

Identification —Fingerprints should be taken where it is at all possible even though the identification has been made These should be kept on file in case of later disputes Photographs should be made of each victim Persons seeking to identify victims should not be permitted to view body or property until after a recognizable description has been recorded This will avert falsification of missing persons lists and identifying a deceased person as an actual living person Wherever possible obtain a record of the dental work which the missing person had had performed

Cross index file on missing persons and bodies recovered Duplicate maps of area One should be marked to indicate site from which bodies were recovered and one marked indicating where missing persons were or supposed to be immediately prior to disaster Consult the city directory or any recent record as to the residents of the vicinity, payrolls of factories in vicinity, etc

Laboratory Procedure —

Where possible autopsies should be performed to determine sex and color, if in doubt, and other significant findings which might lead to identification

X ray pictures

Official Records —Cross index file on missing person, bodies recovered and those identified Punch cards are suggested

Maps of area as described under procedures in identification

Affidavits of identification

Certification of death

Testimony from witnesses as to what happened, who was present, etc

Preserving and Burying the Remains —Mass em

balming A trained corps will prove valuable Mass burial *Records of exact site where body is buried*

Identification Procedure at East Ohio Explosion and Fire — A corps of funeral directors and their assistants had been instructed previously as to their duties and manner of recovery of bodies the necessity of recording information as to the exact site from which the body was recovered and the proper procedure in conveying same to the morgue where they were to wait until all information was to be given to the morgue attendant

When recovery work was started an attempt was made to cover a prescribed area methodically keeping a record of where each set of remains was found The bones from a circumscribed area were placed in separate bags and properly tagged with a catastrophe tag bearing that information

Our primary consideration in all of these cases was to attempt to accurately identify these remains as human and those of a missing person In viewing these bodies at the morgue our normal routine was followed as closely as possible In the early days of the war when there was fear that Cleveland because of its many defense plants would become a bombing target for the enemy the coroner s office in collaboration with the Cuyahoga County Funeral Director s Association formed a catastrophe corps which later became a branch of Civilian Defense Means for identification of the dead were studied At that time a catastrophe tag was designed and printed These were on hand and ready for use The plan was that each dead body should have such a tag attached to his person and that the tag should remain in place until an adequate permanent record could be made at the morgue

As the remains were received at the morgue our usual tags were attached to the body and the catastrophe tags left in place Since every admission to the morgue receives a consecutive number regular morgue case numbers were assigned to each of the bodies Because at the same time routine admissions were being received also it was advisable to designate these disaster victims by assigning a casualty number (e g Morgue case No 59606 Casualty No 5) Thus our records were kept straight and at the same time we had an accurate progressive tally for the information of the public Because of undue haste at the

beginning of the recovery work, a few errors were made, for example, parts of the same body were received at different times and were assigned separate case and casualty numbers, and animal bones were received and given case numbers It cannot be too strongly stressed that undue haste will cause confusion and delay However, in this particular disaster it was not always possible to eliminate the animal bones until x ray pictures were made X ray pictures also served to discover metal social security tags and in one case, a truss, which led to identification X rays were studied to determine the sex, teeth characteristics disease processes and other details which might aid in identification

Two sets of keysort cards were kept One set bore all information concerning the persons reported missing This information included the height, age, scars physical description, any jewelry the person was in the habit of wearing condition of the teeth (wherever possible a complete dental record was obtained) If it was known where the missing person was or could reasonably be presumed to have been at the time of the fire this information was noted also All of this information was coded and the cards punched accordingly

The second set of cards bore the information concerning the remains brought to the morgue This included the case and casualty numbers, a description of the remains (portions of the body), the sex and color (if it could be determined), and detailed description of any property or portion of clothing found with or on the body, the site from which the body was recovered This information was coded and the cards punched

The two sets of cards were matched against each other in the following manner If it was known (for example) that the missing person always wore a ring the second set of cards were sorted to ascertain whether or not there were any rings found on the remains of bodies received, the cards pulled were then compared with the cards of missing persons who wore rings and the other information correlated (All property was left with the body for ten days and then placed in a property envelope bearing the case and casualty number and displayed in a glass case in the lobby of the morgue, with the hope that the relatives of deceased persons might recognize the property)

As stated previously, x ray pictures were made of each set of remains In instances where there was a pelvis it was possible to determine the sex from the study of these pictures Other information gleaned from the study of the x ray pictures led to the identification from jaw bones, previously healed fractures and in one case a truss which was found embedded in the charred pelvis was the means of identification Another manner of sex identification was by partial autopsy

A map showing where bodies were found was compared with a similar map indicating the persons assigned to tasks in each area

After five weeks time the remains which were unidentified (representing 53 persons) were prepared for burial Each remains was placed in a casket which bore a number A record designated the number of the casket which contained the remains of each case and casualty number A circular grave was prepared at the cemetery and records are on file at the cemetery and at the coroner's office for future reference as to the exact location of the grave of each individual

Although identifications were made by the means previously described, for legal protection and proof, it was necessary to prepare several forms of affidavits The first affidavit, in addition to certifying the identification also contained a description of the deceased person This was the first temporary form used in cases where proof of death was needed A second affidavit was to the effect that since a given individual was known to be alive at the time of the fire, and was in the vicinity of the diaster at that time and had not been seen since, it was believed that he or she had perished and was buried among the unidentified

For the East Ohio Gas Company employees affidavits were filed stating that the individual had reported for work on the date of the disaster or had been seen on the premises and had not been seen or heard from since, therefore, it was reasonable to presume that said individual had perished in the fire and was buried with the unknown

In addition, a special coroner's report furnished documentary evidence to the fact that a certain body was brought in from the scene of the disaster, and that by virtue of affidavits sworn to by the relatives, and from the examination of the body, it

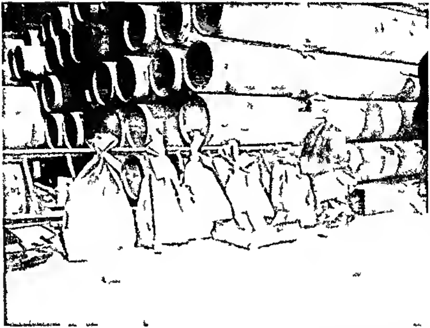


FIG 24 The large water proof bags contain the remains of bodies found after a serious fire Notice the catastrophe identification tags attached The smaller envelopes in the box bear the same serial numbers as the tags and are for keys jewelry and other small articles found with the bodies (Courtesy of Dr S R Gerber)

was reasonable to presume that a certain individual was dead and represented by a specified body brought in from the dis aster area

Identification in Other Disasters—*Fire* at paint factory in which four women were burned Charred pelves were received History obtained furnished information that one woman was pregnant one was a young normal female, one had had a com plete hysterectomy, one had had Fallopian tubes tied off Au topsies performed and the identifications made from ascertain ing this information

Airplane Accident Passenger list of that flight furnished in formation as to the names and addresses of those on the plane At the time of this disaster seat numbers were assigned By following this list and taking the victims out in the proper order identification was easily made

Tug and Barge Disaster Identification of first victims re

ceived were clothing, fingerprints, and papers found on the person Victims who washed ashore as much as eight months later were identified through fingerprints remnants of tattoo marks and other procedures outlined above for disasters

CHAPTER 6

Scientific Criminal Interrogation

BY ALEX L GREGORY

Past President, Academy for Scientific Interrogation

> And he said, "Who told thee that thou wast naked? Hast thou eaten of the tree, whereof I commanded thee that thou shouldest not eat?"
>
> GENESIS 3 11

HERE is the earliest example of criminal interrogation And it was true then as it is so often true today, the suspect's guilt was readily discernible to a wise and competent interrogator Since the dawn of history, interrogation has been the basic foundation of all criminal investigation Unfortunately however, interrogation like many other fundamental principles has been sadly neglected from the standpoint of scientific development Interrogation has always been an art, but only within the past two or three decades has it become a science

The scientific interrogation of suspects and witnesses is just as important as the scientific examination of firearms, documents, blood stains or fingerprints. In fact, without interrogation very little evidence of any kind can be developed for use in court The fundamental questions, what?, when?, where?, how?, and why?, must be answered before the scientific evidence can be used Although scientific evidence helps us answer these questions, it is more often used to verify the answers that have been obtained through interrogation

Interrogation is not an exact science There is no yardstick for either a quantitative or qualitative analysis of an interrogation It can be measured only by its contribution to the accurate solution of the investigation

THE INTERROGATOR

First a competent interrogator must enjoy working with people Any person who does not like other people and enjoy working with them will never be able to command the respect and trust that is so essential to good interrogation *He must be honest with himself and with every person he talks to* Most interrogations are made under some degree of emotional or nervous tension and under these conditions the subject is particularly sensitive to any indication of insincerity No threat should be made that cannot be carried out and every promise must be kept religiously

The interrogator must be firm without being harsh—sympathetic, without being soft or maudlin He must keep complete control of himself both physically and mentally Nervous habits such as tapping lip chewing and ear pulling must always be noticed in the subject but never practiced by the interrogator He must give every impression of self confidence without becoming offensive There is nothing that will inspire confidence in a co operative subject more than a calm dignified self assured manner and this same expression of self assurance will bring an equal amount of fear to a lying subject

The interrogator must make a quick accurate appraisal of the physical mental and emotional qualities of the person to be questioned Upon this appraisal the success or failure of the entire interrogation frequently depends This requires a sound fundamental knowledge of physiology and practical psychology He must be able to recognize the effects of shock fatigue drugs and many of the more common psychological and neurological symptoms of the abnormal person

Not long ago a young man was accused of making advances to another young man Both were interrogated and the accused requested a polygraph test The accuser also agreed to a polygraph test and he was the first to be interrogated His charts contained no indications of deception and the examiner said he was telling the truth The examiner then felt that he had to find that the accused was not telling the truth and he even went so far as to say that the accused was a homosexual The accused was taken to a psychiatrist who found no indications of homosexuality—just a normal college graduate with three

years of military service and no criminal record or abnormal background of any kind Further polygraph interrogations were planned with another interrogator But at the preliminary interview with the accuser a subnormal mental condition was noted and a psychiatric examination was recommended previous to further interrogation It was then disclosed that the accuser was a psychopathic homosexual who frequently had delusions that he was being approached or propositioned If the first interrogator had been careful and had recognized that something was wrong with the accuser a great deal of trouble and unpleasantness could have been avoided

The interrogator must also rely on this original and preliminary interview for the plan of his approach An error here may cost him dearly Should he appeal to the subject s honor? Should he appeal to his logic? Should he appeal to his ego? What terminology should be used? Is the subject a frightened witness who wants to co operate but fears for his personal safety or that of his family? Is he a first offender who may respond to a sympathetic approach or is he an old time repeater who must be convinced with cold logic? These are just a few of the decisions the interrogator must make and usually there is very little time in which to make them because at the same time he must be selling himself to the subject

Before he can start the interrogation he must be completely familiar with all the available facts of the case He must know investigative procedures at the scene in the station and in the laboratory Here again his dignified self assurance is of the greatest importance and can be gained only by experience as an investigator and by doing actual interrogation work It is important to know what evidence was found at the scene and whether or not there were finger or gloveprints There is nothing more reassuring to a guilty suspect than to tell him you have found his fingerprints when he knows he wore gloves Bluffing a suspect during interrogation is just like bluffing in a game of poker—when you get caught you lose the pot The only difference is that when your suspect catches you bluffing he does not tell you He just smiles to himself and gains confidence from your mistakes

Patience is another prime prerequisite of the good interro

gator Often an extra hour or thirty minutes or even ten minutes after you have given up all hope brings success from what appeared to be sure defeat

The ability to speak clearly and to talk intelligently are valuable assets to the successful interrogator The use of Jakie Bum jargon to a successful business or professional man sounds very foolish But many interrogators make the fatal mistake of using the vocabulary and diction of the college graduate when interrogating an illiterate individual or one with a very limited knowledge of our language

The interrogator must always command the respect of the subject under interrogation but to deliberately make him feel inferior is just as bad as failing to meet him on his own level Meet him on his own grounds talk in terms that he is sure to understand Never resort to vulgarity or profanity unless these are the only terms understood by the subject

The good interrogator is not a publicity seeker or a glory grabber He has a job to do and he does it to the best of his ability He must respect the legal and moral rights of his subject and remember that his job is not to get admissions or confessions—*only to get the truth*

Necessary Requirements —The average police officer seldom has ideal conditions for his interrogation work These are usually found only in the laboratory interrogation rooms There are a few necessities however that usually can be obtained at the scene of the average crime

Privacy No one likes to divulge confidential or embarrassing information to a crowd One interrogator at a time will get the best results If he is not successful another can take over but he too should work alone with the subject It may be necessary occasionally to have two present for the sake of safety but only one at a time should handle the actual questioning

Quiet —A successful interrogation is impossible if the officer and the subject have to shout at each other or if noise makes repetition necessary Find the quietest spot possible if the interrogation has to be made at the scene Avoid sudden loud or startling sounds ***And avoid interruptions*** Many a suspect has been saved by the telephone bell or some other distraction just as the interrogator was at the point of getting the truth

Position —It is surprising to many officers that this is a very

important part of the interrogation technique The subject should never be allowed to stand during an interrogation if it can possibly be avoided If there is only one seat the subject must have it A person standing has a psychological advantage over one sitting down The person seated is more apt to disclose telltale indications of nervous tension such as wringing the hands tapping with the fingers or toes pulling the ear or jiggling the foot There are many others that are known to the experienced interrogator who is always on the alert for these signals If the questioning must be carried on in a car always sit in the same seat with the subject where a friendly hand on the knee or arm can often establish a bond of confidence that can never be gained in any other way

Notes and Recordings—The modern recording devices are the ideal answer to keeping a record of an interrogation Some day every police car will carry its own recorder as standard equipment just as today many are equipped with cameras and other scientific apparatus At present notes must still be taken by most police officers doing interrogation work but writing in a note book while the subject is talking not only distracts him but often causes him to be reticent about talking freely It is much better to let him tell his story freely with only such interruptions as may be necessary to keep him from wandering or to guide him when he becomes involved in unimportant details

After he has told his story then go back over it in detail Ask questions about the things he has omitted and try to determine if he omitted them deliberately Emphasize the important details to help him remember exactly what he has said and warn him to be careful and qualify any statement that he is not sure of *It is during this period that the notes should be taken* They will be far more accurate and the information will be fixed much more firmly in the minds of both the interrogator and the subject It may be necessary to have two or even more of these secondary interrogations before the subject s supply of information is exhausted—or if it is a suspect before he tells all the truth Remember it is not confessions or admissions you are after it is just the pure unadulterated truth

After interrogating an important witness or a suspect in a serious crime a signed statement should be taken at the earliest possible moment following the disclosure of any important in

formation This statement may not contain all of the information desired or available from this subject but it is better than nothing which may be the result if the taking of a statement is put off A suspect will often sign a statement giving the detailed facts while he is under the effect of that first shock of fear or remorse Later his only statement may be I want to see a lawyer

The Statement —When the prosecutor takes the statement it is usually in question and answer form This is most effective when presented as evidence It contains a warning of constitutional rights by the prosecutor and a statement by the subject that he has read the statement and that it was made freely and voluntarily

For the police officer who does not have a stenographer available the narrative type of statement is usually preferable This form is most effective if written by the subject in his own terminology which in itself indicates that it was made voluntarily If the statement is to be written by the police officer caution should be used to avoid terms and phrases that would not be natural to the subject

It should first positively identify the subject and be written in the first person giving time and date

> *Example* January 1 1958 10 30 A M My name is John Doe I am 24 years of age I live at 234 East Smith St with my wife Mary and my two children Joe and Jimmy age two and four

The length of residence and place of employment are also identifying factors It should contain complete details of what when where how and if possible why the offense was committed It should close with a statement that he has read the above statement of one two three or four pages that he has initialed all pages that the statement has been made freely without promises of any kind and that he has not been threatened or abused in any way It must be signed and should be subscribed by two witnesses

MECHANICAL AIDS TO INTERROGATION

The history of the development of the various instruments now in use as aids to scientific interrogation is not of any par

ticular significance to the average police officer. However it is important that the police officer on the street have a basic understanding of what can or cannot be accomplished by the interrogator in the laboratory who has these instrumental aids at his disposal

The officer at the scene of a crime should know the fundamental principles of the type of instrument being used in his department's laboratory In most police training courses today, the laboratory interrogator demonstrates to the trainees both his technique and the instrument being used in the laboratory Later many of these young officers should go to the laboratory and observe specific cases as they are handled there This gives them a more thorough knowledge of how the laboratory can be used most effectively in the interrogation of suspects and witnesses

Fundamental Principles.—There are several different kinds of instruments being manufactured today for use in interrogation work These are commonly referred to as "Lie Detectors," but they are actually nothing more nor less than recording devices They indicate and record the physical reaction that takes place as the result of a stimulus applied to a person under certain closely controlled conditions

The principle on which the use of these instruments is based for interrogation purposes is that a deliberate lie, not only requires a mental effort, but also produces the emotion of fear Both of these cause definite physiological changes which can be recorded and measured

There are a great many physiological changes that take place as the result of emotional stimuli, and most people are familiar with the outward indications which were mentioned earlier—the shifty eye, the tapping finger, the dry mouth and others which are usually interpreted as indicative of lying However there are many others, although while not as obvious are much more reliable signs of deception

Those in most common use today are the blood pressure-pulse pattern, the respiratory pattern, and the electrodermal or psychogalvanic response The blood pressure pulse pattern reflects changes in blood pressure, pulse pressure and pulse rate The respiratory pattern indicates all changes in the respiratory

cycles such as periods of suppression signs of relief and the respiratory block The same respiratory pattern is extremely valuable in reflecting the nervous tension of the individual The electrodermal or psychogalvanic response is probably closely associated with the activity of the sweat pores but this has not been definitely established and it may be the result of changes in polarization or some other unrecognized phenomenon

Some of the other physiological changes which have possibilities but have not been developed for practical use are the dilation and contraction of the pupil of the eye the peristaltic action of the digestive tract the electrical activity of the brain as recorded by the electro encephalograph and the secretions of glands other than the adrenals which play such an important part in the present blood pressure pulse pattern

There is no doubt that the most reliable criteria for interrogation purposes are the blood pressure pulse recording followed by the respiratory tracing The electrodermal response seems to be of value at the lower emotional levels but there is a considerable difference of opinion as to its overall value which is shown by the fact that some interrogators use only the electrodermal unit with no recording device at all

If we will recognize the fact that any of these scientific devices are only diagnostic aids we will get a much clearer picture of their value For instance if an expert interrogator uses a blood pressure pulse unit in his work he will achieve a higher degree of efficiency than he would without it If he then adds the pneumograph as the respiratory unit is called he achieves a still higher degree of efficiency If he also uses the electrodermal unit again his efficiency is increased

In all probability these techniques will soon seem as antiquated as does much of the police equipment of the early part of the century but at the preseot time *they are extremely valuable when used properly and extremely dangerous when used improperly*

The Polygraph Interrogatian —During the early part of the interrogation period the examiner using the polygraph follows much the same technique as the officer at the scene of a crime The same rules apply but in the laboratory the interrogation is carried on under the most ideal conditions and is controlled to a much greater degree than is possible outside

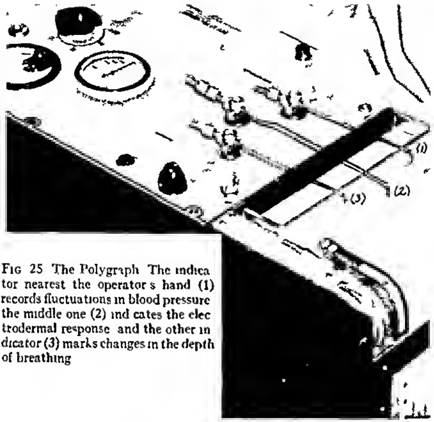


FIG 25 The Polygraph The indicator nearest the operator s hand (1) records fluctuations in blood pressure the middle one (2) indicates the electrodermal response and the other indicator (3) marks changes in the depth of breathing

Here the interrogator must gain the confidence of the subject but he must also establish the subject s confidence in the use of the instrument This has the double purpose of relieving nervous tension in the innocent person but the same procedure increases fear in the guilty and those who are trying to bluff their way through the examination

Formulating the questions to be used in the polygraph tests is a critical part of the test procedure All questions must be framed in the terminology most familiar to the subject They must be worded so there can be a definite yes or no answer Any indecision on the part of the subject during the test might be reflected in the chart as an emotional disturbance

Most effective results are obtained by discussing everything to be asked on the test in the preliminary interview In this way when a question is asked during the test the subject immediately realizes that he has already answered the question during the preliminary interview The questions must be kept as brief as possible to eliminate apprehensive reactions There is some

difference of opinion as to whether the actual questions should be read to the subject previous to the test In fact it does not make a great deal of difference in most cases If there is a great deal of nervous tension to be overcome it may be better to read the questions If the subject has had previous tests he knows about what the questions are going to be anyway

A complete polygraph examination may require anywhere from two tests to as many as fifteen or twenty, depending upon

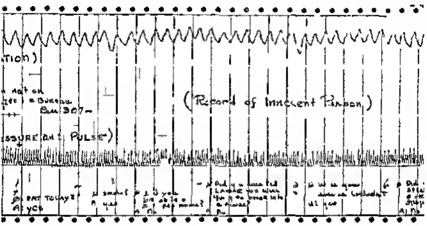


FIG 26 Record of an innocent person Note the evenness of blood pressure and respirations From *Annals of Internal Medicine* XVIII 551 1943

the nature of the case under investigation As a general rule from three to five charts are all that will be required for the interrogator to arrive at an accurate diagnosis Of these at least two must contain the same pertinent questions which are interspersed with irrelevant questions The others may be control tests map tests, peak of tension tests or additional general question tests The number of examinations will also be determined by the amount of material to be covered

A good interrogator will make the first general question tests as comprehensive as possible These should indicate whether the subject was involved or has any knowledge of the offense under investigation *If these first tests indicate that he has no knowl*

FIG 27 Questioning a subject on the polygraph This shows the electrodermal response unit attached to the subject's left hand The record will be taken on the middle pen The pneumograph tube is adjusted around the chest and the blood pressure cuff about the right arm The examiner is Lt W M Petermann and the subject is posed by Lt Don Berry of the Michigan State Police *From Annals of Internal Medicine XVIII 331 1943*

edge of the offense there is no object in asking him about the details If guilty knowledge is indicated in these first tests then the details should be covered by subsequent tests A series of short tests causes less fatigue to the subject and the interpretation of these charts is much easier and more accurate

Making the chart is the most simple phase of the entire polygraph interrogation technique With a little practice the interrogator can become familiar with the operation of the instrument The most important part of this phase of the interrogation is to get the best chart possible for each individual subject The accuracy of the interpretation or diagnosis of any chart is directly affected by the quality of the patterns secured

The subject is seated in a chair that is comfortable but he should not be permitted to lounge. Both feet should be flat on the floor, the back should be erect without rigidity.

The pneumograph or respiratory unit is placed around the chest, the blood pressure cuff is placed around the upper arm (some interrogators prefer the wrist cuff) and the electrodes of the galvanometer attached to the hand or fingers. The blood pressure cuff is inflated and the electrodermal unit is adjusted to the individual requirements of the subject.

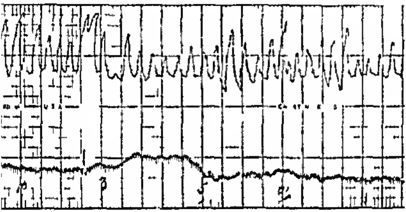


FIG. 28. A portion of a control test used to determine whether the subject could react to a stimulus. He was asked to select a number between 1 and 10, write it on a piece of paper and put it in his pocket. The examiner then instructed him that he would be asked about each number while attached to the polygraph and told to answer each question "no" even when asked about the number he had selected. The chosen number turned out to be 3, and note in this graph the rise in blood pressure in the lower tracing and the shallowness of breathing in the upper tracing following the figure 3.

The chart is then started and allowed to run for a period sufficient to establish a normal pattern without any questions being asked. This may require from thirty seconds to two minutes and will produce the normal pattern for this individual at this particular time. The patterns of any subject can change materially within a very short period of time and a new normal must be established at the beginning of any new series of tests.

From this point on each polygraph examination will vary. It is up to the examiner to determine the number of tests the

number of questions per test, the type of tests, and the controls that will be required to arrive at an accurate diagnosis

Important —From this point on the voice of the examiner must be under complete control *There must be absolutely no emphasis on any word, phrase or sentence,* unless it is intended for control purposes

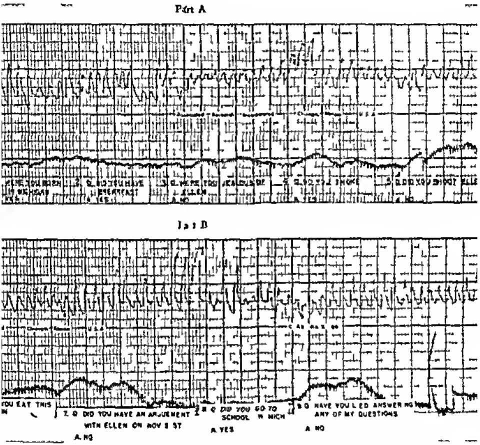


FIG 29 A woman by the name of Ellen was reported missing and it de veloped that she had deserted her four children in northern Michigan and was living in a house trailer near Lansing It was further discovered that she had been keeping company with a factory worker who was also married and had four children Several days later his wife reported to the police that while intoxicated he had told her that he had shot Ellen and buried the body in the back yard of their home The body was recovered shortly after and it was found she had been shot in the head by a 22 caliber bullet Her husband was arrested for investigation and the above charts illustrate his reactions on the polygraph In particular note the definite reactions to questions 5, 7 and 9 From *Annals of Internal Medicine,* XVIII 551, 1943

The usual polygraph examination will contain the following minimum requirements, if maximum efficiency is to be achieved

Normal.—From thirty seconds to two minutes of chart during which no questions are asked This establishes the normal for this individual at this particular time. If he is requested to return for further tests at a future time another normal must be established at that time

Irrelevant Questions.—It is wise but not always necessary to run one test using only the irrelevant or relief questions This helps to relieve the fear of the highly nervous individual, of the technique itself and the slight discomfort caused by the blood pressure cuff It also establishes a normal pattern of responses which may result from anticipation

Example A Is your first name Fred?
B Is your last name Green?
C Do you now live in Michigan?
D Do you now live in Lansing?
E Are you twenty five years of age?
F Is today Friday?

General Questions.—The general questions test is always started by two irrelevant questions to absorb the apprehensive tension that is present in most subjects

Example A Is your first name Fred?
B Is your last name Green?
1 Do you know who robbed the grocery at 1st and Ash Streets last night?
C Do you now live in Michigan?
2 Did you yourself rob the grocery at 1st and Ash Streets last night?
D Do you now live in Lansing?
3 Did you have anything whatever to do with this robbery?
E Are you twenty-five years of age?
4 Are you deliberately concealing or withholding any guilty knowledge of the robbery at 1st and Ash Streets?
F Is today Friday?
5 Have you deliberately lied at any time during

this entire interview? (Notice this question covers the entire interview and not just the test questions)

This series of questions must be covered at least twice If there are no indications of specific reactions in the first chart and none appear as the pertinent questions are asked in the second chart some of the irrelevant questions may be omitted Experience will be the only means of determining the spacing of the irrelevant questions in subsequent tests

The Peak of Tension Test.—The peak of tension test, the location test and the control tests are used at the discretion of the examiner.

The peak of tension test is particularly valuable if all of the details of the crime have not been disclosed to the subject during previous interrogation For example a burglary has taken place and entrance was gained through an unlocked bathroom window on the second floor The suspect has denied committing the crime and says he does not know how entrance was made The questions for the peak of tension test might go like this

1 Was entrance made through a basement window?
2 Was entrance made through 1st floor dining room window?
3 Was entrance made through 1st floor kitchen window?
4 Was entrance made through 2nd floor bathroom window?
5. Was entrance made through 2nd floor bedroom window?
6 Was entrance made through 2nd floor den window?
7. Was entrance made through door on upper deck?

All of the questions are read to the subject previous to the test and of course, he denies that any of the questions have any significance to him However, if he is guilty he will recognize question No 4 immediately and as the test proceeds his nervous tension will increase until question No 4 is reached then he will relax and his tension will diminish through the rest of the questions This test has any number of variations, but the entire success of this test is based on the principle that the subject has never been told the answer to the key question His disturbance must come as the result of personal knowledge So remember, ***during an interview early in the investigation don't give all***

the details to the suspect but keep an ace in the hole for the polygraph examiner

If the polygraph is to be used at all it should be used early in the investigation The best results are obtained with subjects who are rested and refreshed Long periods of interrogation previous to the polygraph tests are frequently the cause of errors by inexperienced examiners who do not recognize fatigue that has been caused by protracted periods of questioning

The following case is an excellent example of the danger of using the polygraph after a long period of interrogation especially by an untrained examiner At the same time it illustrates the advantage of polygraph interrogation over inadequate personal identification

In August 1951 in one of the western states a cab driver was killed and his passengers robbed as they were returning from an evening at the races and night club entertainment The murder weapon a single shot 22 calibre rifle was found and six suspects all of whom had had an opportunity to possess the rifle were picked up by the police for questioning and for identification by the passengers who were robbed

One of the police officers in the city where the crime took place had been doing some interrogation with one of the more popular types of polygraph but he had never had an opportunity to get any training in the use of the instrument

As the suspects were brought in they were placed in a show up and were interrogated at length Following the interrogations they were turned over to the officer for polygraph tests One of the suspects was finally identified by the robbery victims This suspect had once been the owner of the rifle used in the killing he had also been at the races the night the robbery and killing occurred and had called the man who was robbed a dirty name for spilling whiskey on his wife

At this point in the investigation the Chief of Police decided to get a more experienced polygraph interrogator After a complete series of polygraph tests and an extensive interview it was the opinion of the interrogator that this man whom we will call Jerry had not committed the robbery and killing During the interview he had been asked who he thought would be the most logical suspect in the group of six who had access to the rifle He

said the only one he could possibly suspect would be Bob who had been in three show ups and had been given a polygraph test by the local police officer The witness said Bob was *not* the man and the police officer gave him a clean record on the polygraph

Bob was again brought in by the police and interviewed by the experienced interrogator He refused to permit further polygraph tests His common law wife was then brought in and she too refused to permit interrogation on the polygraph She was questioned for several hours and finally she stated that she was in the car when Bob committed the robbery and murder She told where a money clip had been thrown after the robbery This was found and Bob also confessed to the robbery and killing

Why did the victims identify Jerry the other suspect but were not able to identify Bob who actually committed the crime? The face of Jerry was fixed in their memory because of the altercation in the bar after the whiskey was spilled and because this had taken place before they had done any excessive drinking They failed to recognize Bob due to poor lighting conditions at the scene of the crime excessive drinking and extreme emotional tension

But why did the local police officer fail to pick out Bob as the guilty suspect? What went wrong with his polygraph interrogation? Bob s polygraph charts contained no disturbances of any kind in response to questions about the crime

First of all Bob had been interrogated for several hours by other police officers and when they were unable to get anything from him he was turned over to the polygraph examiner Because of inexperience the examiner failed to recognize the smooth pattern which so frequently indicates fatigue Also through inexperience he failed to use the controls that are an essential part of every polygraph examination These controls indicate to the examiner that the subject is capable of responding physically to an emotional stimulus

The honest but mistaken witness is one of the most serious problems in our system of justice He not only convicts the innocent but he permits the guilty to go free and unfortunately the mistaken witness is all too frequently the most positive

The witness who is too positive should receive special attention from the interrogator Many of these exceedingly positive witnesses are nothing but crackpots trying to be the center of attraction. Every statement of a witness of this type should be verified if possible by other witnesses A confident witness will greatly strengthen any case, but an over-confident witness usually does more harm than good

MEDICAL AIDS TO SCIENTIFIC INTERROGATION

While the mechanical aids to scientific interrogation have been dubbed "lie detectors," the medical aids that have been used for the same purpose have been called "truth serums" The most accurate and acceptable term for this type of interrogation is *"narco analysis"*

This type of interrogation should be carried on only by interrogators of long experience, and while the subject is under the care of a competent physician who administers all medication and who has available all the drugs and equipment that might be required for the protection of the subject if an unfavorable reaction should be encountered

The most common drugs used in this field and those which have seemed to produce the best results are pentothal, amytal, and scopolamine All of these drugs have been in common use in the field of psychiatry and, of course, they will be recognized as three of the most common drugs used in hospitals today Some experimental work has been done with other drugs such as ether, nembutal, nitrous oxide, and seconal, but apparently no degree of success has been reported

The use of drugs in the field of scientific interrogation should not be confused or compared with the use of mechanical aids like the polygraph These two techniques complement each other, but are not substitutes for each other

For example a suspect is to be interrogated about a robbery The first thing to be determined is whether or not he committed the robbery or has any guilty knowledge of it Of course he denies any guilty knowledge so he is given a polygraph examination which indicates that he not only has guilty knowledge, but that he actually participated in the commission of the crime All normal methods of interrogation fail to get the desired in

formation from the suspect, so he is asked to submit to narco analysis, or medical interrogation The underlying principle is that at a point very close to unconsciousness he will be mentally incapable of resistance to interrogation and incapable of fabricating the falsehoods that he has used to conceal his guilt

This might be compared to a search for buried treasure The polygraph is used to locate the treasure and the drugs are used to aid in the removal of the treasure, or at least to make the digging easier

The use of drugs for interrogation without the preliminary use of the polygraph is like promiscuous digging for treasure You may find it and you may not but the fact that you didn t find it does not prove that the treasure was not there When drugs are to be used for interrogation purposes a written release of liability should be secured by the interrogator and the physician

Interrogation under Hypnosis —Questioning under the influence of hypnosis has received very little attention so far in the field of scientific interrogation There has been no indication that it has any value whatever in detecting deception or in securing information from an unco operative suspect or witness

There does appear to be a strong possibility that hypnosis may have a definite value in reviving the memory of the co operative subject It is well known that some people under the influence of hypnosis have been able to recall incidents and details that they had long forgotten

Here too, much experience and caution are required It is a technique to be used only by those with a great deal of training and who have the necessary background to evaluate the results

Interrogation of Children and Low Intelligence Adults — Great care must be used in the interrogation of young children They are frequently the only source of information available to the examiner and their value should not be underestimated Many young children have exceptionally keen powers of observation as well as unusually good memories

There are three rules that should be remembered when interrogating children and the third is also true with low intelligence adults

1 Stick as closely as possible to questions and answers If

the child is allowed too much freedom of narration it is difficult to limit him to facts When children are the center of attraction they are apt to mix imagination with truth

2 Treat children as much like adults as possible during interrogation When treated like an adult, the child is more apt to talk and act like one

3 Avoid suggestions This is the most important rule and it is particularly true when working with a child or low intelligence adult who is trying to be helpful These people are so anxious to help they automatically give the answer they think the interrogator wants When getting a description never select the comparison for them Force them to point out someone who is about the same build height or complexion Make them select their own choice of colors when describing clothing hair or automobiles If they know the names of automobiles and can identify them let them point out or describe without help If they are identifying a gun let them pick one out of a group

When identification of people or objects is made in this manner the witness will remember it but if he merely agrees with the suggestion of the interrogator he will probably be easily confused by the opposing attorney when the case comes to court

Scientific interrogation is an art The picture that is portrayed may not be pretty, but it must be accurate and convincing

CHAPTER 7

Homicide Due to Gunshot Wounds

GENERAL CONSIDERATIONS OF FIREARMS

THE FIRST requirement an officer must possess to intelligently investigate homicides due to firearms is a general knowledge of guns, ammunition and the fundamental principles of firearms identification There are many excellent books on this subject and it is outside of the scope of this work to go into the details of firearms manufacture However, there are a few fundamentals which will be briefly considered to aid the investigator in his survey.

Manufacture of a Firearm.—The first thing which is of importance for the officer to understand is the construction of a gun barrel and what happens during its manufacture which may influence the investigation of a crime The process of manufacture starts with a solid steel bar which, when drilled from end to end, makes it a steel pipe. After the drilling process, the inside of the barrel is made very smooth by a process known as *lapping*. We now have the barrel of a smoothbore gun.

In our Revolutionary War period this was the common type of firearm, but, of course, the only type of bullet which could be fired accurately was a round lead ball These guns were very accurate for short distances but there were certain fundamental defects The principal trouble was that it was impossible to make a lead ball heavy enough to fit a particular barrel so that it would have any great striking power. In addition, the lead balls did not fit the barrel accurately. A considerable part of the blast from the burning powder would escape in front of the ball and this would likewise lower the efficiency of the piece. Furthermore, to get the best possible affect from the burning powder, the gun barrels were very long and this made them unwieldy

and difficult to aim. An attempt was made to compensate for some of these complications by lengthening a lead ball into the shape of a modern bullet, thus increasing its weight and striking power. However, when a bullet of this kind was fired from a smooth bore gun, it was very inaccurate because it would start to tip over in its flight and lose velocity rapidly.

Consequently, some method had to be devised so that the

FIG. 30. Cast of a rifle barrel. The wide spaces were made by the *grooves*, the narrow ones by the *lands*.

bullet would travel throughout its entire course without wobbling and tumbling. This could be done by imparting a spin to the bullet at the time it was fired, thus making each bullet a miniature gyroscope. The method of doing this was to cut *spiral grooves* on the inside of the barrel leaving a space between the grooves which is known as the *lands*. These would bite into the side of the soft lead bullet while it was passing through the barrel and thus give the bullet its spin in addition to its forward motion. It is this process, known as *rifling*, which is the most important factor in the whole subject of firearms identification. *Firearms identification is commonly and improperly known as ballistics.* Ballistics is the science of the flight of projectiles and is only distantly related to the identification of firearms, bullets and powders.

Rifling.—Rifling is now done by modern machine tools which automatically cut the spiral grooves on the inside of the barrel and impart to every gun characteristics which are peculiar to that barrel alone and which cannot be duplicated in any other barrel. To begin with, each manufacturer has his own characteristic design for the lands and grooves. He has his individual pattern which determines whether the grooves are inclined to the right or to the left, and likewise their width, depth and pitch. For example, a Smith and Wesson revolver has five grooves

which are inclined to the right, while a Colt has six grooves which are inclined to the left These are the individual characteristics of the manufacturer of these weapons

In addition to these peculiarities there are other markings left by the rifling tool which cuts the grooves This rifling tool is a small bit which is just the width of the groove It cuts the

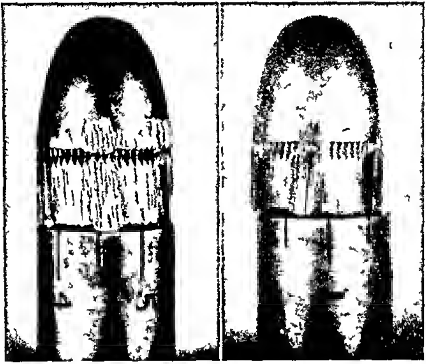


FIG 31 A 38 calibre bullet *fired* from a *Colt* which has six lands and grooves *inclined to the left*
FIG 32 A similar bullet fired from a *Smith and Wesson* which has five lands and grooves *inclined to the right*

grooves by being drawn several times through the barrel in a spiral motion A method of rifling in common use today is by means of a *broach* which is drawn through the barrel only once and cuts all of the spiral grooves in a single operation In the steel of the barrel are minute flecks of hardness which cut notches into the edge of the bit as it is dragged along Consequently, in each groove are a series of small scratches which conform to the edge of the bit each time it is pulled through This series of scratches changes with every operation of the

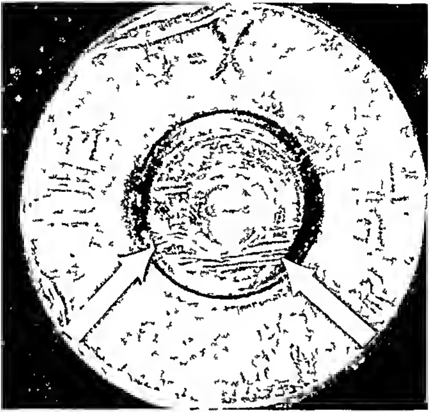


FIG 33 A fired shell showing scratches on the primer caused by tool marks on the breech facing When a cartridge is fired the explos on not only forces the bullet out of the barrel but with equal force it drives the shell back against the breech of the gun The primer being made of soft metal will p ck up any scratches or tool marks on the breech facing and these markings on the primer will be characterist c of that particular fire arm and none other Consequently it is extremely important to carefully collect and mark all fired shells found at the scene of a crime

rifling tool and of course changes from groove to groove It can thus be seen that it is absolutely impossible for two barrels even if made by the same manufacturer on the same machine, to have the same pattern of scratches When a lead bullet is fired through this barrel, these characteristics of the gun barrel will be transferred to the sides of the bullet so that bullets fired from a certain barrel will have characteristics which are peculiar to that particular firearm and to no other

CAUTION Do Not Cut or Tear This Page

TEST BULLET

FIG 34 The lower picture marked FATAL BULLET is a bullet removed from the victim s body The upper picture marked TEST BULLET is a bullet fired from the gun found on a suspect Note how the scratches on the lands and grooves flow from one onto the other proving conclusively that both bullets were fired from the same weapon

In like manner other machined parts of the mechanism such as the firing pin, extractor pins the breech facing will likewise impart marks to the primer or shell which are characteristic of that particular weapon and to no other Thus it is possible when a bullet is found in a dead body or an empty shell near where a gun is fired, to tell whether that bullet or shell was fired in any particular weapon which may be suspected of having fired the fatal shot

Characteristics of Revolvers and Automatic Pistols —The two common types of weapons fired from the hand are the revolver and the automatic pistol These have certain characteristics which must be borne in mind

A *revolver* has from five to seven cartridges loaded in a cylinder which rotates each time the weapon is fired so as to bring an unfired cartridge in line with the barrel It can only be unloaded by tipping the cylinder sideways and pushing the fired shells out with the ejector Consequently, the entire load of bullets can be fired without any of the empty shells being extracted so that it is rare to find empty shells at the scene of a homicide where a revolver has been used

An *automatic pistol*, on the other hand, has the cartridges loaded into a clip which fits into the handle The weapon depends upon the recoil mechanism to discharge the empty shell and throw a fresh cartridge into the chamber

Thus it is seen that every time the weapon is discharged an empty shell is ejected and, generally, *is lying a few feet to the right of the spot from where the gun was fired* (See Fig 64)

Another difference between the two firearms is *the type of ammunition used* Ammunition for use in revolvers almost always has lead bullets Lead bullets however, do not work well in an automatic pistol due to the fact that they are apt to jam when fed into the chamber This is overcome by covering them with a metal jacketing which is somewhat harder than lead and takes a polish This jacketing is not so hard that it will not conform to the rifling of the barrel It used to be true that practically all revolver ammunition was loaded with black powder while automatic ammunition was loaded with smokeless powder This, however, is not true today as most modern revolver ammunition is loaded with smokeless powder In spite of that there

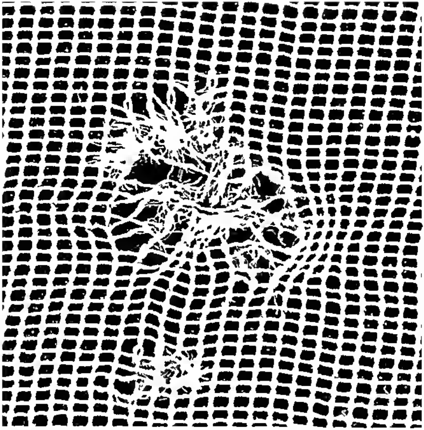


FIG 35 The body of a woman who disappeared was found several weeks later in a canyon The soft tissues were entirely gone and all that remained was the skeleton and some clothing A hole was noticed in the brassiere *(greatly magnified)*

are many homicides by guns using old revolver ammunition still loaded with black powder

CLOTHING MARKS ON BULLETS

A lead bullet fired from a revolver may strike a person wearing clothing which has a hard coarse weave In such an instance the weave of the cloth is often stamped onto the nose of the bullet If such a bullet is discovered in the investigation of a death it may be the only proof that a murder has been committed The body may have been dead for a long time before being discovered so that all evidence of gunshot wounds and the track of the bullet are entirely obliterated Consequently, whenever a lead bullet is found, before the surgeon or officer scratches his identification mark upon the bullet *he should examine it carefully for evidences of the clothing pattern* If such a pattern is

found care should be taken to avoid mutilation of this pattern with his identification mark (see Figure 36)

Fig 36 Fabric mark on bullet Embedded in the earth directly underneath the body was found this bullet The weave of the brass ere can be plainly seen on the nose This was proof that this bullet had passed through the body and that the shooting took place with the body in the position in which it was found (Figs 35 and 36 Courtesy of Leland V Jones Los Angeles)

GENERAL CONSIDERATIONS OF GUNSHOT WOUNDS

On arrival at the scene, the investigating officer may be confused as to what was the mechanism causing death If it seems likely that gunshot wounds were the cause, he should try to determine four things

1 Was death due to a gunshot wound or to an injury inflicted by some other instrument?

2 If by a gunshot wound, from what distance was the firearm discharged?

3 From what direction were the shots fired and what was the position of the body when hit?

4 Was it an accident, suicide or murder?

GENERAL CHARACTERISTICS OF BULLET WOUNDS

Strange as it may seem it is not always easy to determine at once whether the wounds which caused death were due to a bullet or some other instrument For instance it is possible for a bullet to cut a gash in the scalp or shoulder which greatly resembles a knife wound Frequently bullet wounds of the chest are seen which could easily be mistaken for an injury caused by some pointed instrument such as an icepick In many of these cases it requires minute careful examination to determine their true nature

When a bullet strikes and passes through a body the wounds of entrance and exit will have certain characteristics which will vary with the following conditions

1 The type of ammunition

2 The distance from which it was fired

3 Whether or not the bullet first struck some other object (ricochet)

4 Whether or not it passed through clothing

5 Whether or not it struck a bone in its course through the body

Wounds of Entrance —Having determined that the death was due to bullet wounds it is of first importance to determine the wound of entrance and the wound of exit When a bullet strikes the skin it first produces simply an indentation of the skin due to the fact that skin is both tough and elastic and the tissues underneath are not resistant Consequently the skin

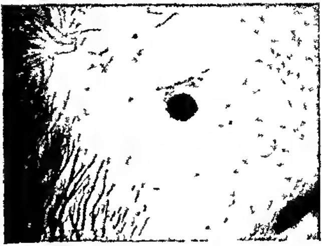


FIG 37 Wound of entrance on the forehead The absence of smudging and tattooing indicates that the muzzle of the firearm was not held close to the head Note that there is practically none of the gray ring around this wound This is due to the fact that the skull is directly under the skin and prevents indentation and stretching of the skin at this point Consequently, there is but slight contact between the side of the bullet and the skin edge (Courtesy of C W Muehlberger)

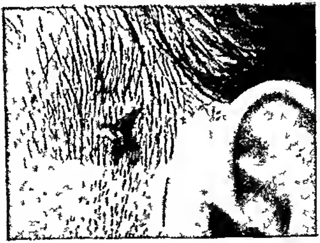


FIG 38 Exit wound of the same bullet Note the fact that the exit wound is much larger than the wound of entrance is ragged torn and shows more tissue damage (Courtesy of C W Muehlberger)

Fig 39 Bullet wound of *entrance* at the base of the middle finger The fist was shut when this wound was received (Courtesy of G Russell Carter)

immediately under the nose of the bullet is put on a stretch The bullet which has rotation as well as forward motion is definitely slowed up at the point of contact but finally more or less bores its way through the skin and on into the body In this process a small area of skin around the bullet hole comes in contact with the sides of the bullet where it wipes off smoke and grime which is deposited as a gray ring around the wound of entrance

Due to the fact that the skin is stretched by the bullet in its passage through it then returns to its former position and the size of the wound of entrance appears to be smaller than the diameter of the bullet which made it If the bullet strikes the skin at an angle, the gray zone around the hole will be somewhat wider on one side and correspondingly narrower on the other Generally there is only a small amount of bleeding from wounds of entrance due to the fact that tissue destruction is not great at that point To summarize ***typical wounds of entrance are neat round holes with an even gray ring around them and from which emerges comparatively small quantities of blood***

Wounds of Exit —As the bullet passes through the body its velocity is rapidly retarded and it has a tendency to pack the

FIG 40 The wound of *exit* Note that it is much larger ragged and torn Farther down on the palm of the hand is a spot where the nose of the bullet penetrated the outer layer of skin When the fist was opened after death the bullet was lying loose in the palm of the hand (Courtesy of G Russell Carner)

tissues in front of it If it has enough momentum to go clear through the body, it finally bursts its way out through the packed tissues Consequently, ***wounds of exit are much larger than the bullet, are ragged, torn, and generally the escape of blood is much greater than in wounds of entrance*** Often shreds of fat or other internal tissues will be extruding from the wound

Next to bone, the skin is the most resistant tissue in the body It is a frequent occurrence that a bullet will go clear through the body only to be stopped by the skin on the opposite side where it can easily be felt

Effects Produced by Bullet Striking Bone —If the bullet encounters only soft tissues in its passage through the body, it will pass through in a straight line If, however, it strikes a bone it is hard to predict where it will go When this happens, the deflection of the bullet depends upon the size and shape of the bone, the velocity of the bullet, and the angle at which it strikes In some cases, if a high velocity rifle bullet strikes a large bone, like that in the thigh, it may bore a hole through it without even producing a fracture On the other hand, if it happens to strike a large bone at an angle, it may cause a severe fracture with great destruction of the surrounding soft tissues due to the fact that the energy of the bullet is transmitted to broken fragments of bone and thus making each of these fragments an ad

ditional projectile Not only do the bone fragments enormously increase tissue destruction but the bullet itself is frequently sent spinning end over end This, of course, greatly increases tissue damage and bleeding As a result, the wound of exit in such cases is usually much larger, more ragged and generally more destructive

One of the most common instances of the deflection of bullets is when they strike the chest at an angle After penetrating the skin, the bullet will frequently strike the breast bone or the ribs and will be deflected between the ribs and skin It may then go clear around the chest and come out in the back without having passed through the chest cavity at all These cases are frequently encountered when a person attempts suicide by shooting himself through the heart The same thing sometimes happens when a bullet strikes the skull at an angle and goes around the head between the scalp and the bone

Fig 41 Contact bullet wound of forehead Notice the charring of the edges and the star shaped tears of the skin due to undermining of the scalp

FIG 42 The same bullet wound as in Fig 41 with the scalp reflected forwards over the face Notice how the blast has undermined the scalp singeing and blackening the surface of the skull (Figs 41 and 42 Courtesy of Police Department of Santa Ana California)

FROM WHAT DISTANCE WAS THE FIREARM DISCHARGED?

The distance from which a firearm was discharged can be classified into three zones

1 Those in which the muzzle of the piece was held directly in contact with the skin or practically so

2 Those in which the muzzle was held from about two to eighteen inches away

3 Those in which the muzzle was held from eighteen inches or more

Contact Wounds —Contact wounds are inflicted by the muzzle of the firearm being held directly against the skin at the time of discharge Such a wound is made by the penetration of the bullet and also the flame and expanding gases produced by the burning powder The principal damage visible is due more to the flame and the muzzle blast than to the penetration of the bullet It is a dirty looking wound, considerably larger than the diameter of the bullet and the skin edges are ragged and torn In addition, there is actual charring of the tissues due to the tremendous heat from the muzzle blast

The tearing of the tissues is especially marked when the muzzle has been held directly against the head as so frequently happens in suicides The skull, which lies just underneath the scalp provides definite resistance which impedes the expanding gases from the muzzle with the result that they somewhat undermine the scalp, producing a ragged, torn, charred wound which is often much larger than the wound of exit Frequently this results in error on the part of the investigating officer if he interprets the wound of entrance as the wound of exit and, in trying to rationalize his findings concludes that death was due to murder rather than to suicide

Exception —A rather rare exception to the general appearance of contact wounds is encountered when the muzzle of the piece has been pressed very firmly against the skin and the underlying organs are of such a nature as to allow for the expansion of the gases In such cases the wound of entrance may be clean and round, greatly resembling the wound of entrance made by a bullet fired from a considerable distance Usually such wounds are found on the chest but some have been reported where the muzzle has been pressed against the skull The determination that one is dealing with such a contact wound can only be verified by an autopsy which will disclose the charring and destruction of the underlying organs from the muzzle blast

Wounds Inflicted at a Distance from Two to Eighteen Inches —If the gun is discharged when held close to the victim, two types

Fig 43 Contact wound (*upper left picture*) of the forehead Note the large ragged wound with charring of the skin edges See Figure 44

Fig 44 Exit wound made by the same bullet (*upper right picture*) It is much smaller than the contact wound of entrance It is an exception to the general rule that exit wounds are larger than entrance wounds and care must be taken not to be misled by that fact (Photograph by Send & Send)

Fig 45 Probe inserted through the entrance wound (forehead) and exit wound (*lower picture*) to indicate the direction of the flight of the bullet

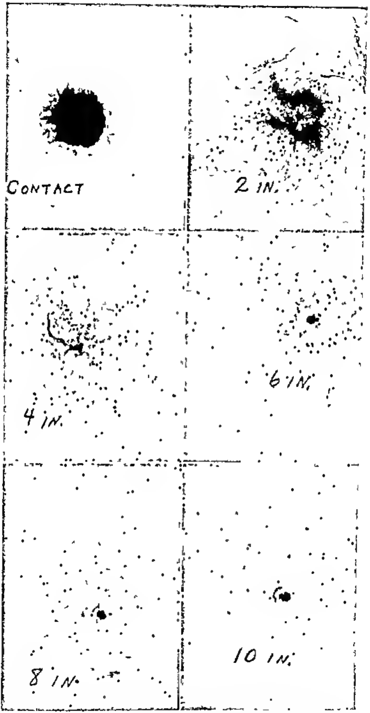
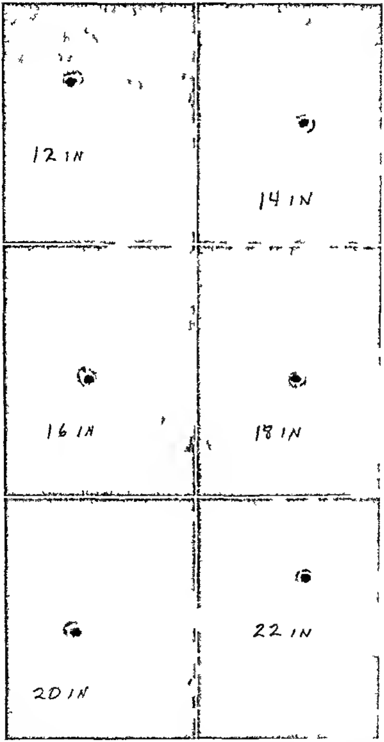


FIG. 47: A series of test shots through blotting paper with a .38 calibre revolver. The ammunition was loaded with smokeless powder. Notice that smudging is almost absent at a distance of six inches. In making an esti-



mate of the d stance from wh ch a shot was fired in an actual case if poss ble use the same weapou and ammun tion employed in the homicide.

observer looks carefully he will occasionally notice that the smudging and granule marks are not distributed evenly around the bullet hole but that the most of them or even all of them may be to one side of the wound of entrance If these markings cover only a small area and are almost entirely confined to one side of the bullet hole, it signifies that the muzzle of the gun was held very close to the skin and at a sharp angle to the surface This is noticed sometimes in the case of suicide gunshot wounds of the head The victim starts out by holding the muzzle of the firearm firmly against the right temple As he prepares to pull the trigger he subconsciously draws his head to the left and the direct contact with the muzzle is broken Frequently at the time of discharge the gun is riding with only the forward sight against the skin and the opening in the barrel three quarters of an inch or so removed from direct contact The pattern made by the discharge of a gun held in this position is shown in the accompanying illustration Take particular notice that the great bulk of the smudging and tattooing is *forward* of the bullet hole and thus gives an accurate indication of the direction and general angle at which the gun was held

Authors on the subject of bullet wounds have mentioned the fact that where the bulk of the smudging and tattooing is distributed to one side of the wound of entrance that it may be caused by the kick of the weapon When the cartridge is fired the bullet leaves the muzzle of the gun first, followed by the expanding gases and the burning powder This causes the gun to kick throwing the muzzle off the target and the kick is always in the direction of the sights This causes the smudge and powder granules to be deposited more on one side of the bullet hole than on the other and the side of the greatest deposit indicates the side on which the sights of the gun were mounted In spite of the fact that this has been observed by others and I have seen this distribution myself, I have some reservations as to how it is produced I have never been successful in reproducing it with test shots It is my belief that when this unequal distribution of powder markings around the bullet hole is observed that it is caused by an angle shot rather than due to the kick of the gun In discussing this point with Van Amburgh, he concurred in this belief as to the cause of this uneven distribution

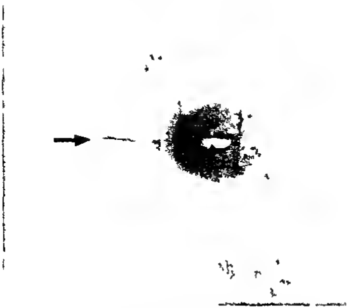


FIG 48 Smudge pattern on blotting paper made by firing 32 calibre revolver at an angle of 45 degrees The foreward sight was in direct contact with the paper as is shown by the groove at the left Notice that the bulk of the smudge is deposited forward of the bullet hole and that the pattern in that region has a much more sharply defined border The arrow indicates the groove made by the forward sight and also the direction of fire

Wounds Inflicted from a Distance of More Than Eighteen Inches —Beyond a distance of about eighteen inches or twenty four at the most, evidence of smudging and tattooing are seldom present In such cases the general description of wounds of entrance and exit as related earlier in this chapter will apply

Ricochet Bullets —Occasionally, however the officer may be confused because he finds a wound of entrance which instead of being neat and round is large, ragged and torn He may know positively that it is not a contact wound Such an injury is often produced by a somersaulting bullet known as a ricochet which is caused by the bullet glancing off a deflecting surface such as a wall, pavement, tank, steel rail body of water or similar objects

GENERAL CHARACTERISTICS OF SHOTGUN WOUNDS

The shotgun is the most deadly weapon with which the police officer has to deal and it figures very frequently in both suicide

Fig 49 Shotgun entrance wound behind the right ear The skin edges are charred from the muzzle blast

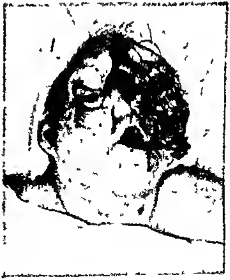


Fig 50 Exit wound on the same subject This illustrates that when fired at close range, the effects of a shotgun may be devastating (Courtesy of C W Muehlberger)

and murder It seems that nearly every farmhouse in the country has a shotgun behind the kitchen door and these frequently become involved in crimes, especially during the hunting season

There are several factors which cause trouble for the investigating officer There are not only four or five common gauges in use, but there are double barreled guns repeaters and an infinite variation in the shells used These range from very fine shot for use in shooting small game to buckshot which are commonly used in hunting deer Then, too there is considerable

FIG 51 Shotgun entrance wound The gun was fired from a d tance of less than ten feet through the clothing Notice that a section of the chest wall about the size of a silver dollar has been completely carr d a vav (Courtesy of G Russell Carner)

variation in the powders used, the types of wadding and other material employed in the manufacture of the shell To complicate matters still further, there are adapters used for firing rifle bullets from a shotgun and also cartridges made for firing a large lead bullet which depends on deep spiral grooves cut into the side of the bullet to give rotation as it passes through the air However, by far the most common type of gun which is found at the scene of a shooting is the single barreled 12 gauge shotgun of cheap manufacture

When a 12 gauge shotgun is fired at a person from a distance of about ten feet or less the shots come in such a compact mass

that they will blow a hole through the abdominal or chest walls up to about the size of a silver dollar Beyond ten feet the shot will have scattered sufficiently so that there will be a pattern of individual shot penetrating the body but without a central hole in which the tissues have been completely carried away If this large wound from a shotgun fired at close range happens to be in the abdomen, almost always there will be intestine and other abdominal contents which are forced out of the hole and will be lying in a mass outside of the wound Beyond ten feet, the pattern of shot will become more scattered in proportion to the distance The size of this pattern will also be influenced by whether or not the shotgun is *chokebored* By chokeboring we mean that the muzzle is narrowed slightly so as to concentrate the shot into a small pattern Double barreled guns frequently have one barrel smoothbored and the other chokebored To determine accurately the distance from which the gun was fired, it is necessary to make test shots with the particular weapon used When the shotgun has been held in direct contact or very close to the skin, we see burning singeing and charring of tissues much the same as in contact wounds due to revolvers and pistols

A load of bird shot fired from twelve gauge gun will ordinarily not emerge from the chest or abdomen of an average sized adult even when the muzzle is held in close proximity to the body

If the victim is struck in some thinner portion of the body, such as the neck or shoulder the wound of exit will be very large and lacerated, provided the structure is thin enough for the entire load of the shot to emerge If the penetrated part of the body is thicker, only a few of the shot may completely penetrate the tissues, causing a wound of exit which may be small, even smaller than the wound of entrance

Wadding —Shotgun shells use wads made of compressed paper or felt to separate the powder charge from the shot, and other wads to keep the shot from falling out of the cartridge In the case of wounds made by a shotgun fired from a distance within ten feet, the wadding will almost always be found buried deeply in the tissues of the body It is important that they be recovered and preserved, because they indicate the gauge of the gun used The retention wad also often has printed upon it

the make of the shell, as well as the size of shot and type of powder When a shotgun is fired out of doors the wadding seldom travels beyond 40 or 50 feet and if a diligent search is made, the wadding can often be found *It should always be looked for and frequently proves to be of great importance in identifying the gun used*

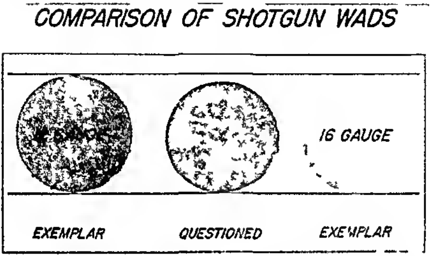


FIG 52 The questioned over powder wad was removed from the abdominal cavity approximately 10 days after death It was thought to be a 12 gauge wad but extensive tests made on various wads showed that they expand upon being immersed in blood and other body fluids The photograph shows a comparison between the questioned wad and two exemplars one a 12 gauge and the other a 16 gauge wad The lines above and below the wads are exactly parallel and establish the diameter of an unfired 12 gauge wad The minimum diameter (vertical in picture) of the questioned wad corresponds to a 16 gauge wad whereas the maximum diameter (horizontal in picture) corresponds to a 12 gauge wad As a 12 gauge could not shrink to this extent the one in question was proved to be a swollen 16 gauge wad (Courtesy of William W Harper Pasadena)

When wadding is recovered saturated with blood and tissue fluids the expert must use extreme care in determining the gauge of the gun from which it was fired because the wad may swell so that it is no longer exactly round It has a tendency to expand lengthwise of the fibers Serious mistakes have been made in making this determination (see Figure 52)

Has Shotgun Been Recently Fired?—Before the last war the primers of all shotgun shells were loaded with mercury fulminate There are some exceptions to this since the war but the

great majority of shotgun shells are still loaded with this material When the gun is discharged mercury vapor is deposited on the inside of the barrel This will remain for a few days and then gradually disappear

The presence of mercury vapor may be detected by an electrical device and if found it indicates that the gun has been fired recently A situation may arise where a body is found dead from a shotgun blast A suspect may claim that his gun has not been fired for a long time but if there is a laboratory within a reasonable distance which has a mercury vapor detector, take the gun at once to have this test performed Be sure to close the breech and plug the muzzle with a cork or efficient seal so as to prevent the further escape of vapor until tested

ESTIMATING DIRECTION FROM WHICH SHOTS WERE FIRED

It is often impossible to determine the position from which the firearm was fired from an observation of the body wounds alone, but if all the available evidence is carefully noted, the question can usually be answered If the shooting was done indoors and the bullet passes completely through the body, it can generally be found embedded in the wall, furniture or floor If the person was lying on the floor or ground, the bullets can be recovered from their position underneath the body Lining this point up with the wounds of entrance and exit on the body gives a definite clue to the position from which the gun was fired Likewise, from the same evidence, a good indication may be obtained of the position of the deceased when hit

When a person is struck by more than one bullet, it is frequently possible to tell not only the position of the body when each bullet struck it but also the order in which they were fired For example, late one night, the writer examined two dead bodies lying within three feet of each other on a street corner One was the town marshal who died of a shotgun wound Fired at close range, the charge had struck him in the chest under the right armpit The other body was that of a man who had been threatening his wife, who worked until 2 00 A M in a restaurant The marshal was escorting her home when they met the husband unexpectedly on the corner and the shooting started The hus

band had been struck by four bullets One of these bullets struck the index finger of the left hand came out of the palm of the hand and then entered his right shoulder to emerge from the back Another bullet went through his left forearm about mid way between the wrist and elbow and then struck the same arm halfway between the elbow and shoulder indicating that his

FIG 53 Shotgun entrance wound of the upper abdomen Fired from a short distance a hole about the size of that shown in Figure 35 has been made allowing a loop of intestine to protrude (Courtesy of G Russell Carner)

elbow was bent and held high supporting the shotgun A third bullet struck his left shoulder in the crease of his armpit and emerged in back The fourth bullet hit him squarely on the top of the head and came out below and behind his right ear

Reconstructing this shooting it is apparent that both men were in firing position when the shooting started The marshal had his right side toward the other man with his right arm in firing position as the shotgun charge entered below his right armpit without injuring his arm It is also evident that the husband had the shotgun to his shoulder in firing position when

he was first struck, as the bullets which hit his left arm and left hand indicated The bullet which entered the top of his head was fired when he had dropped to his knees with his head bent forward From this it would appear that the marshal fired first and discharged the first two shots and possibly a third before the shotgun went off Even after he was hit by the shotgun charge, he was still able to fire another shot, striking the falling husband on the top of the head This illustration tends to show the importance of the proper examination of the wounds in explaining the circumstances of what happened at a shooting

WAS IT AN ACCIDENT, SUICIDE OR MURDER?

Sudden Death from Gunshot Wounds—In discussing this subject, it is important to stress the fact that instant death from gunshot wounds is a rarity In the case cited above, the shotgun wound suffered by the police officer was devastating, and any one of three of the bullet wounds suffered by the other man would probably have killed him, yet both were able to fire their weapons after receiving these wounds Even after penetrating bullet wounds of the heart, a person may do extraordinary things The writer recalls the case of a police officer who was shot by a gangster through the heart with a bullet from a 38 special He was not knocked off his feet and after receiving the wound, took out his own revolver, fired all six loads, put it back in its holster, walked across a wide street and climbed into his automobile where he died

Recently a twenty year old youth was shot in the abdomen by a twelve gauge shotgun from a distance of six feet The charge had made a hole about the size of a silver dollar through the abdominal wall just below the lower rib margin, two inches left of the midline After receiving this wound, the boy ran out of the house and called for an ambulance When seen in the hospital over an hour later, a mass of abdominal contents as large as could be covered with both hands had extruded through the hole onto the abdominal surface Although in severe shock, he was still conscious, could answer questions and lived for about two hours after the shooting The autopsy showed that the stomach, kidney and spleen had suffered terrific injury and the upper part of his abdomen was simply a mass of blood,

fragments of organ tissues, stomach contents, wadding and shot. *It is always hazardous to conclude that a person could not have done some rational act after receiving gunshot wounds in vital organs.*

Importance of Survival Period.—In attempting to determine whether a fatal gunshot wound was inflicted by a murderer or by the victim himself, it is well to bear in mind that many

FIG 54 Shotgun entrance wound when fired from a distance of about ten to twelve feet (Courtesy of G Russell Carner)

murders are committed under intense emotional excitement Consequently a murderer is more likely to fire several bullets into the victim to make sure that he is dead before leaving the scene A suicide on the other hand frequently shoots himself but survives the fatal wound for a considerable period of time Therefore, other factors being equal, a period of survival following the fatal wound favors suicide as the cause of death.

Apparent Cause of Death Often Misleading.—In determining whether a fatal wound was accidental or suicidal, the investigator is often on very thin ice. Frequently suicidal deaths are cunningly planned to appear accidental for the purpose of the insurance which is involved One should always be suspicious of a death due to the discharge of a firearm while it is being cleaned Likewise, suicidal deaths are sometimes planned to appear to be due to murder for the sake of the insurance.

Some time ago a man was found in his basement garage, dead from a bullet wound. His pockets were turned inside out and a few small coins were scattered on the garage floor. No gun was in evidence A broken flower pot on the window sill led to further investigation which eventually disclosed the revolver attached to a long rubber strap which had pulled it through a hole in the

FIG 55 Detailed view of the same wound as shown in Figure 54 While a solid block of the chest wall has been carried away, the wound edge is not sharply defined and there are the marks of several scattered shot outside the border (Courtesy of G Russell Carner)

ceiling back into a partition. The man had killed himself He had accomplished his purpose by attaching one end of the long rubber strap back inside the partition so that when he released the gun from his hand it would disappear through the hole in the ceiling. When he actually killed himself, the gun struck the flower pot on the window sill before it was pulled out of sight and this led to uncovering the deception

Nor is it always safe to assume that what appears to be a suicide may not be a death due to natural causes Only recently

the writer examined the body of a man 64 years old who lived alone in a farm house His dead body was discovered with a revolver close at hand Evidently he had killed himself by putting the muzzle of the gun in his mouth A hot water bottle containing frozen water was also found in the bed At the autopsy an examination of the head showed that the bullet had entered the roof of his mouth in an upward direction, had fractured his skull and was lying underneath the scalp in the left front part of his head When the complete autopsy was done, however, it was revealed that the aorta, which is the large blood vessel that carries the blood from the heart out to the tissues, had ruptured The pain from such a condition is terrific It was quite evident that he had tried to relieve himself with a hot water bottle and failing to get any relief, in desperation had shot himself However, the actual cause of his death was the ruptured aorta rather than the perforating wound of his head This was a matter of great comfort when it was explained to his family who were at a loss to understand why he should have attempted to kill himself In the whole field of homicide investigation this illustrates the dictum to ***take nothing for granted because things are not always what they seem***

A frequent cause of confusion arises in a situation where the muzzle of a firearm has been tightly held against light clothing at the time of the discharge The laboratory expert may run a C acid test on the clothing around the bullet hole (described in the following chapter) and finding no powder granules embedded in the clothing, conclude that the gun had been fired at such a distance as to render suicide impossible The muzzle of a gun tightly held against light clothing may produce a very effective seal so that the entire blast enters the body and is absorbed by it, leaving no smudge on the clothing or skin In such a situation the doctor performing the autopsy should not only carefully examine the tissues within the body for evidences of muzzle blast but ***he should gently scrape out the wound of entrance with a small curette and save the material removed*** This material should then be spread upon a piece of filter paper and the same reagent applied which is used in the dermal nitrate test Unburned particles of powder are likely to be included in the removed material and produce the characteristic color reac

tion when the reagent is applied If nitrate particles are found within the wound of entrance and the C acid test on the clothing is negative for a scattering of powder particles around the bullet hole, the proof is complete that the victim suffered a contact wound

Some general observations may be made on suicidal gunshot wounds By far the majority of them are inflicted in the head Most of such wounds are inflicted in the right temple, usually at a point just above and in front of the ear In these cases, the gun is usually held directly against the skin or practically so If the weapon happens to be an automatic pistol, sometimes the imprint of the muzzle and the front sight will be left on the skin, due to the impact from the recoil Occasionally a person will shoot himself twice in this region These wounds are not always immediately fatal It is not at all uncommon for a person to live for several hours or even days after a wound of this kind, and occasionally they will even recover One should always look with great suspicion on wounds of entrance *on other parts of the head,* because they are much more likely to be due to murder

The next most common type of gunshot wound of the head is caused by placing the muzzle of the gun directly in the mouth If the lips have been closed over the gun, there will usually be excessive tearing of the cheeks If the bullet has passed through the back part of the brain and skull, it is likely to be fatal much more rapidly than where the front part of the brain has been penetrated

It is amazing how frequently bullet wounds of the head go unrecognized The hair may be long and matted and if a careful examination is not made, a bullet wound may be overlooked For example, I recall going to see a dying man who had been shot two days before in the left shoulder with a 22 calibre rifle This man was in a hospital and had been there since the time of the shooting From the wound which he had received, it was hard to understand why he should be dying in such a manner Another injury was suspected, and a careful examination of the scalp revealed that he had also been shot behind the right ear For two days that wound had been unrecognized and unknown The mere fact that the man had been shot twice instead of once,

as had been published in the papers, led to the capture of the murderer a few days later.

If things don't look quite right about a gunshot death, be sure that a bullet wound in the head has not been overlooked.

Probably the next most common site where a suicide tries to shoot himself is through the heart However, when a revolver or pistol is held in the natural manner, it is difficult for a person to shoot himself through the heart. As was described previously, the bullet often ricochets and glances off the breast bone or ribs In such a case, it does not penetrate the chest at all, but follows around under the skin and comes out in back Others often miss the heart entirely and penetrate a lung or the upper abdomen Of the attempts at suicide in this manner, probably one-half are unsuccessful.

Rifles and shotguns are too long to be well adapted to suicidal purposes, however, they are so used Nearly always a stick or a string tied to the trigger, which goes around the trigger guard, is used to discharge the weapon. In these cases, the muzzle of the gun is nearly always in direct contact with the body, and the device used for firing the piece makes suicide obvious. Occasionally, some other method may be used to discharge a firearm such as pushing the trigger with a toe Some rifles, principally 22 calibre, have a barrel short enough to allow it to be fired by hand. However, it is almost impossible for a person to shoot himself in such a manner except in the head.

A peculiarity about suicidal gunshot wounds is the reluctance on the part of suicides to shoot themselves through clothing. Particularly when a shotgun has been employed, it is common to find that the clothing has been loosened to permit the muzzle to be placed against the bare skin

Another point, previously mentioned, is the finding of a gun in the dead person's hand One should not be in a hurry to snatch this gun away, but should examine carefully to see if it

FIG 56 Shotgun entrance wound The shot wounds make a pattern ten to twelve inches in diameter indicating that the gun was fired from a considerably greater distance than in the case of the wound shown in Figures 54 and 55 To determine accurately the distance from which the gun was fired it is necessary to make *test shots* with the same weapon and ammunition (Courtesy of G Russell Carner)

is tightly grasped by the dead hand If it is one can be certain that it was there at the time of death It is impossible to place a gun *in the hands of a dead man so that it will be tightly* grasped after death

Double barreled shotguns which are in faulty condition will occasionally discharge both barrels when only one trigger is pulled. This fact has been used to explain two widely separated shotgun wounds in a body in an endeavor to establish the cause of death as accidental or suicidal This explanation is erroneous because if both barrels discharge when only one trigger is pulled,

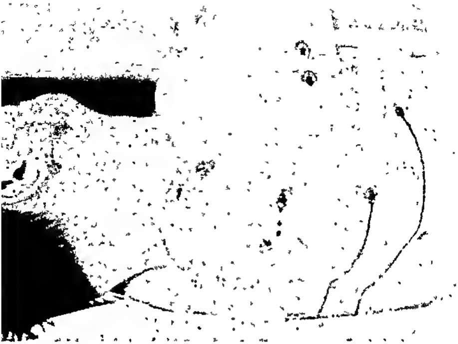


FIG. 57: Wounds of entrance caused by buckshot. Due to their *weight*, the penetrating power of buckshot is great. (Courtesy of G Russell Carrier.)

the two explosions are practically simultaneous and the wounds produced are side by side.

Hesitation Shots.—An investigating officer is sometimes confused at finding a body which is apparently a suicide from a bullet wound, where only one bullet has entered the body. When he examines the room he finds evidences of several shots having been fired and an examination of the gun may show it was discharged several times. He may draw the erroneous conclusion that there has been a gun fight and that the man was murdered. Van Amburgh has pointed out that these are usually suicides and has called these extra shots *hesitation shots*. The victim, when he points the gun at his head, subconsciously pulls away from it at the moment of discharge, with the result that the bullet misses him completely. This may be repeated two or three times before he finally turns the gun directly upon himself and fires. Evidence of hesitation is found in some other forms of suicide such as the marks or *hesitation strokes* found on the neck of a person who has cut his throat.

the development of the test In 1931 T Gonzalez of Mexico City improved the technique of applying the paraffin and first demonstrated the test in the United States in 1933 Later Israel Castellanos, Director of the Cuban National Bureau of Identification at Havana, and R Plasencia added further refinements to the technique

At the instant of discharge, there is a certain amount of escape of gases and burning powder around the breech of the weapon These particles of unburned powder strike the hand that is holding the weapon and become implanted into the skin This leakage of powder and gases is more apt to occur when the gun fired was an old weapon of cheap manufacture In a new, well made firearm, the breech mechanism is better fitted Consequently, the discharge of these substances is greatly lessened or entirely absent

The test is performed by making a paraffin cast of the back of the person's hand If particles of unburned powder are present, the paraffin penetrates the minute crevices of the skin and when the cast is peeled off, some of them will be extracted A reagent which will determine the presence of nitrate particles is then applied in the laboratory and, if found, the technician can determine whether they were due to powder granules If there is a question as to whether the deceased may have fired the gun himself the hands should be protected until such a time as the laboratory technician can make the cast and run this test The hands are best protected by covering each with a paper bag and tying the opening around the wrist In this way they can be safeguarded as long as necessary

Other substances such as fertilizer or cigarette ashes may give a positive test, *therefore*, it is unwise and hazardous for anyone but a laboratory expert to attempt the procedure If a person is found who is suspected of having fired the bullets the test should be applied even though a day or two has elapsed and he has had an opportunity to wash his hands between times In some instances I have found the test positive three days after the shots had been fired even though the hands had been washed many times in the interim Negative findings do not rule out the possibility that a certain individual may have fired the shots

FIG 59 A deer hunter was found dead from a rifle shot which had entered the center of his chest and emerged one inch to the right of the midline of his back Investigation lead to the belief that only two persons could possibly have shot this man—one armed with a .31 calibre Japanese army rifle using jacketed ammunition and the other using a .30 calibre Winchester firing soft nose bullets Three months after death the body was disinterred and a section of the spine removed with the flesh and skin attached This photograph shows the inner surface of this tissue and the bullet hole has enlarged considerably due to shrinkage of the soft tissues The problem was to try to determine whether the victim had been killed by jacketed ammunition or a soft nosed bullet

but positive findings may add greatly to the weight of evidence against him

Locating A Missing Weapon—A common problem in the investigation of deaths due to gunshot wounds is a situation when the body is found and the fatal bullet recovered but the firearm which fired the shot cannot be located It is extremely important that this gun be found or accounted for From the examination of the bullet the firearms expert can usually identify the calibre type of ammunition whether it was fired from an auto

matic pistol or revolver and frequently the make of the gun If the registration of firearms is in force in that locality it may be of help in locating the missing weapon

However, it may be even more helpful to take advantage of the fact that nearly everyone who owns a firearm knows one or

FIG 60 An x ray photograph of the specimen shown in Fig 59 Notice the numerous flecks of lead scattered through the tissues strongly indicating that the wound was caused by soft nosed ammunition

more people who possesses a similar weapon The coroner or police may insert a notice in the paper, that in connection with the investigation of a particular murder all known firearms of the type in question are going to be checked The owners are re quested to co operate and present themselves and their gun at some suitable place for this purpose Of course the murder weapon will not appear at this check up but the owners may be

questioned concerning other similar guns that they know about and a card file prepared on it

Two things are accomplished by this procedure First the number of possible guns which may have been used to commit the murder is narrowed down Second, this procedure effectively puts the murderer under pressure so that he or others that know of the crime may do or say something which may bring about an important break in the case This procedure combined with the judicious use of the lie detector may produce extraordinary results If it appears that the missing gun might have been thrown into a ditch along the roadside where it is covered with ice and snow the use of mine detectors may be very helpful The use of magnets for searching the bottom of rivers under bridges or around docks has recovered many guns Modern crime laboratories should have such equipment available for this purpose

Absorption of Lead Bullets — If a lead bullet remains in the body of a living person it generally becomes encapsulated by scar tissue and remains permanently However, in some areas there is little opportunity for scar tissue to form about the bullet, consequently the tissues attempt to get rid of it by absorption Cases are on record of when several lead bullets have remained in a body, the amount of absorption has been sufficient to produce lead poisoning Jacketed bullets are too hard for much absorption to take place and consequently are little affected

PROCEDURE AT THE SCENE OF THE SHOOTING

When an officer arrives upon the scene of a shooting, he is usually confronted by a condition of utter confusion Neighbors and onlookers are crowded about the place relatives are weeping and hysterical In his career as an officer he will meet with few other situations which require as much poise, tact and common sense as when he appears upon the scene of a homicide

His first duty is to clear the premises of all persons so that an intelligent investigation can be carried out To properly investigate the circumstances is not a matter of five or ten minutes, but it requires that a definite routine shall be followed, if mistakes are to be avoided Things should be done, which may appear

FIG 61 Confirmatory tests were made by firing a jacketed bullet with the Japanese army rifle through an uncooked piece of beef This photograph is an x ray of the beef and the dark shadows are end views of the ribs The arrow indicates where the bullet emerged after penetrating a rib Notice that there are no metallic particles in the tissues around the point of exit

wholly unnecessary at the time, but only to become vitally important later One can never foresee the angles that will develop, and it is far better to do a hundred things unnecessarily than to miss doing one that might mean the solution of the case The victim is dead and will stay dead for a long time. The officer may be importuned by reporters or others to do things which he is not yet ready to do—to give statements to the press or to draw conclusions. ***In spite of all persuasion, he should bear in mind that there is one purpose and one purpose only, and that is to carry out an intelligent investigation.***

Upon receiving a call to the scene of the shooting, the officer should always take along a loose-leaf notebook and fountain pen to make notes at the time and on the place and not trust to his memory to reconstruct the situation at his future convenience.

When the officer is summoned on such an errand, his proce dure should follow a logical pattern In addition to the sugges tions in Chapter 2, the following steps are particularly applicable to the investigation of homicides due to firearms His observa tions should be put *in writing at the time of his investigation* to keep for future reference and to produce in court if necessary These steps are as follows

1 Note accurately in writing the time he received the call and by whom it was sent

2 Note accurately the time he arrived on the scene and the correct address

These first two items may seem to be trivial, but it is amazing how often in court they become of vital importance It is not uncommon that the officer is unable to fix the time accurately within an hour to the satisfaction of a jury

3 He should ascertain if the victim is dead, and if not sum

FIG 62 The same piece of beef after shooting through a rib with the Winchester and soft nosed ammunition The numerous flecks of lead shown in the soft tissues are similar to those seen in Fig 60 and prove that it was soft nosed ammunition and not a jacketed bullet which killed the man

mon medical aid or remove the body to a hospital Otherwise the body should not be disturbed

4 Immediately clear the premises of all bystanders, and under no circumstances allow anyone to touch or remove anything in the vicinity

5 Use every effort and means to identify the deceased

6 Does the body lie where the shooting took place? Often before the officer arrives the body will be moved by a bystander Frequently it will be picked up off the floor and put upon a bed or taken from one room to another

7 Take the names and addresses of all witnesses and take written notes on the statements of as many persons as practicable

8 Photograph the body from all angles to show its relationship to doors, windows, furniture and other objects in the room

9 Measure with a tape the exact distance of the body with relation to the previously mentioned fixtures of the premises

10 Note in writing the exact position where he found the body, whether he found it lying on the side, back or abdomen, what objects if any, were in the hands, report what was the condition of the clothing and the amount of bleeding

11 Examine the ceiling floors and furniture for bullet holes, blood stains fired bullets, fired shells or shotgun wadding

12 If there is a firearm at the scene, he should note in writing the following observations

a Exactly where found

b Type of weapon—automatic pistol, revolver, rifle or shotgun, calibre or gauge designation

c Make, lot number and serial number, and at that time he should mark his initials on the butt or frame of the weapon for future identification

13 If close to a reliable firearms identification laboratory, the weapon should be rolled in paper with a minimum of handling and taken there without unloading Otherwise he should unload the weapon and observe certain precautions

First, to avoid spoiling fingerprints which may be on the cartridges If the weapon is an automatic pistol, the most favorable spot for finding fingerprints is on the clip He should be

careful not to smudge it He should never forget that after the clip is removed *there is still a loaded cartridge in the chamber* and the gun is therefore dangerous until this cartridge also is removed The ammunition should be marked on *the* nose for further identification (See Chapter 8)

14 If a shotgun was used in the shooting and it is desirable to determine whether or not it was recently fired, close the breech, plug the muzzle with a cork so that it may be taken to a labora tory for a mercury vapor test

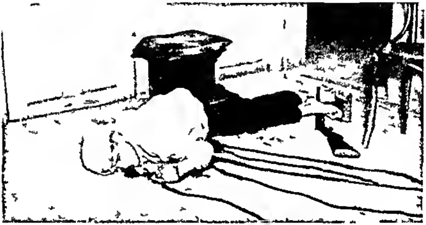


FIG 63 Suicide by use of a shotgun The victim sat on the stool in the background and fired the gun with his toe

15 If the exact time of the shooting is unknown he should note if body heat is still present by feeling the skin under the clothing and examine for rigor mortis as described in Chapter 3

16 Transport the body to a morgue, after first making sure that loose bullets are not lodged in the clothing or under the body If the investigator is not a coroner, the body must not be moved until examined by that officer and his permission for re moval obtained

PROCEDURE AT THE MORGUE

After the body has been removed to the morgue, there are certain other duties which should be done before an autopsy is performed

1 If there is any question whatever as to whether it was suicide or murder, the laboratory expert should take paraffin casts for the dermal nitrate test

2 Fingerprints should be taken, if not previously done, even if the body is already identified This is necessary in order to identify fingerprints which may be discovered later in the investigation of the case, and it is necessary to determine if the deceased might have made them

3 Remove clothing and label If there are bullet holes preserve the clothing for laboratory tests Never stick your finger or a pencil through a bullet hole and avoid handling the area around it There is sometimes a question whether a hole in the clothing may be due to a bullet or from some other cause Walker of Boston has demonstrated how this may be determined by soft x ray technic A lead bullet, in passing through clothing will leave deposited on the fibres a slight amount of lead which will show up beautifully under proper x ray examination

4 Tabulate all articles in the pockets and on the person The coroner should retain custody of these until the case is disposed of

MEDICAL NOTES ON THE AUTOPSY

If a doctor is summoned who has had long experience in performing medicolegal autopsies, he will know how to carefully investigate the case However, it is frequently necessary to employ the services of a doctor who has had much less experience in this field It is well to converse with him before the autopsy is started so that he will know what information is desired from his examination ***If an autopsy is worth doing at all it is worth doing right the first time***

The following are the essential elements of a careful examination

1 Photograph the unclothed body to show clearly bullet wounds of entrance and exit Also if possible photograph with probes in the wounds of entrance to indicate the direction of the flight of the bullets

2 Do a complete autopsy even if the body cavities are not penetrated One is often surprised at what will be disclosed in

some instances. *He should remember that the purpose of a medicolegal autopsy is not only to determine the cause of death but to rule out every other possible and conceivable contributing cause of death.* Elements are often introduced into a case to raise a doubt in the minds of a jury, and normal findings at an autopsy are frequently just as important as finding the apparent cause of death. It is well to carry out the additional suggestions contained in the chapter on the medicolegal autopsy.

3. If a sexual assault is suspected, a careful examination of the sex organs should be made. Further details in respect to this matter are discussed in Chapter 18

4 Make an examination of the stomach contents to determine the time that has elapsed since the last meal.

5. Note carefully the organs traversed by the bullets

6. If it appears possible that a bullet wound of entrance migbt be a contact wound, gently curette out tbe wound of entrance and save the material in a clean receptacle for the laboratory expert to conduct a test for powder granules

7. Remove any bullets if present being careful not to scratch tbe bullets with instruments in the course of the removal At the time a bullet is removed, *the doctor should make an identification mark upon the nose of the bullet* after first taking care to see tbat it is not a lead bullet with the weave of the fabric imprinted upon the nose If such a fabric print is present, his mark should be scratched on the butt of the bullet but under no circumstances should it ever be placed on the side If the body is badly decomposed, it may be very difficult to find the bullets In that event, x-rays of the head, chest, abdomen and limbs will locate them.

8 Bullets, clothing and other scientific exhibits should then be delivered to the laboratory After being properly labeled and identified, tbey should be delivered in the manner described in Chapter 8.

Chapter 8

The Preservation and Transportation of Firearms Evidence

BY CHARLES M WILSON*
Superintendent Wisconsin State Crime Laboratory

In this treatment of the subject of *the handling of fire arms evidence*, no attempt is made to explain the details of the laboratory examination of such evidence If additional information of this nature is needed the author suggests that the reader consult Hatcher's[1] excellent text on this subject

In criminal cases which have been brought to a successful conclusion and in which firearms have been involved it is often the case that the final outcome will turn upon a single exhibit or piece of evidence Unless this physical evidence which is recovered at the time the investigation is made, is carefully preserved so that it will not be mutilated or altered and so that it may later be properly identified by the officer who originally recovered it the value of the piece of evidence may be entirely lost

Police officers, investigators deputy coroners deputy sheriffs and others concerned with the initiation of criminal investigations are of course only human And they, like everyone else are oftentimes inclined to reach conclusions concerning the facts in the case before there is a sufficient foundation for such a conclusion In many instances they voice to someone else their

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[1] Hatcher J S *Textbook of Firearms Investigation Identification and Evidence* (1935)

preconceived ideas as to what the facts are, and then too often after this has been done they are bound in their investigation to substantiate their original speculations rather than objectively seek the causative factors which are the basis of the establishment of facts

It might be well for all law enforcement officers who are concerned with any type of investigation to realize that an investigation conducted *today* may be the object of a careful and searching scrutiny *years hence*. It would be reasonable to view with suspicion the testimony of an officer who, from memory alone, could recall all the details of an investigation which he may have conducted five or ten years previous to the time that he is asked to recount the details This serves to emphasize the importance of the investigator's taking careful notes of details at the time an investigation is made This is most important The courts will permit an investigator to refer to his notes for the purpose of refreshing his memory when he is testifying on the witness stand This does not mean that he is permitted to read from his notes but he is permitted considerable leeway in the direction indicated

In homicide investigations which involve the use of firearms great care must be exercised in the matter of recovery, marking and the preservation of the evidence which may be recovered

It should be mentioned, when firearms are recovered, care should be exercised so as not to obliterate possible latent finger prints on the weapons It should also be borne in mind, particularly with reference to cases involving the recovery of auto loading or automatic firearms that the gun should be handled keeping in mind the possibility of accidental discharge of this type of weapon

It is believed best to have a person qualified in developing and photographing fingerprints do the actual processing at the point where the firearm is recovered If this is impossible, it is suggested that a pencil be placed through the trigger guard of a hand gun and in this manner it can be transported with the minimum amount of handling In cases involving rifles, shot guns, etc , one end of a piece of string or rope can be tied through the trigger guard and the other end around the barrel in the vicinity of the front sight and the weapon carried by the sling

arranged as suggested. If the firearm is of the auto-loading or automatic type, care should be exercised so that it will not be accidentally discharged while being transported to a point where the latent fingerprints can be processed. With this type of weapon it should be remembered that the smooth metal surface of the clip will often retain identifiable fingerprints; in addition, loaded cartridges still in the clip may have latent impressions on the cylindrical wall of the cartridge. If fired cartridge cases are recovered, they also may retain latent fingerprint impressions.

In the course of an investigation, fired bullets, fired shells, guns, powder patterns (either on the victim's skin or on his clothing), or shot patterns are often encountered, and ordinary common sense rules of preservation of this type of evidence should be kept in mind by the investigator. It should also be borne in mind, as has been pointed out, that the full significance or value of any particular exhibit as an aid in the establishment of the facts may later prove to be a crucial one. Each exhibit, then, should be carefully preserved on the assumption that it may be the single piece of evidence upon which the issue may turn, and it is well for the investigator to be alert to the fact that he may be subjected to a very thorough and searching cross-examination as to the condition of the evidence at the time it was recovered. In addition, he may be questioned as to the circumstances surrounding the acquisition, and the matter of handling, marking, and the preservation of that particular piece of evidence.

Admissibility.—If physical evidence is offered before a court of record, then the question of its admissibility as evidence must be satisfied from the time it is recovered until it is offered in evidence. If the exhibits are to be examined in the laboratory, then, in addition, they must be so preserved that they will not be contaminated or mutilated and so affect the results of any objective laboratory examinations which may be made involving them. If we are to assume that the physical evidence recovered will be subsequently offered in evidence and accepted by a trial court, then we must satisfy the accepted rules governing the admission of such evidence. In the trial of a criminal case the state must be prepared to offer testimony relating to the follow-

ing five important points regarding the recovery and handling of physical exhibits offered in evidence

1 Testimony must be offered as to the circumstances under which the exhibits in question were acquired
2 Testimony must be offered as to the condition of the physical evidence at the time it was recovered, as compared with its condition at the time it is produced in the courtroom
3 Testimony must be offered as to the legality of the methods employed in acquiring evidence
4 Custody of the exhibits must be shown or traced from the time they were recovered until offered in evidence
5 If any alteration has been made between the time the exhibit was recovered and the time it was offered in evidence this must be justified and accounted for, usually by the laboratory technician who will testify as to chemical or physical alteration incidental to and necessary in his examination

In addition to the requirements of the trial court if the exhibits are to be subjected to a laboratory examination the requisites of the laboratory must be satisfied These may be summarized as follows

1 Exhibits must be protected against mutilation alteration or contamination
2 Accurate information as to the source and relative location of the exhibits at the time they were recovered

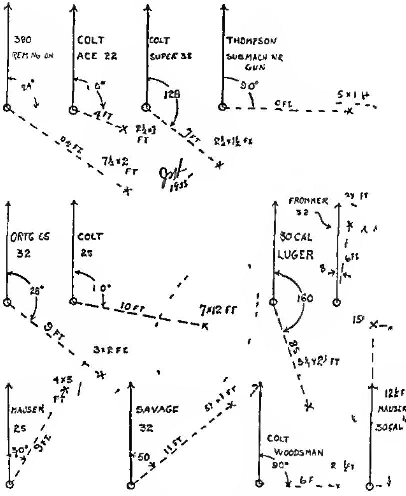
Crime Scene Photographs and Diagrams —When the body of a victim in a homicide investigation is examined by the investigator, the best method of preserving the particular position in which the victim was found is to make scaled photographs of the area in which the victim's body was recovered If this photograph is later to be used in court, it is well to keep in mind that the area in which the body was recovered must not be disturbed It must be left in precisely the same condition as when the victim's body was discovered This refers principally to the matter of moving articles of furniture curtains or the movement of the body itself

It is often found that where fired cartridge cases have been ejected from repeating or full automatic firearms these fired shells will not show in the photograph In this instance two scaled photographs should be made one of the scene as it was first viewed, as has been suggested, and a second scaled photograph should be taken, locating in the field of the camera with suitable placards or markers any small objects such as a fired cartridge case, bullet holes in walls etc Supplementing the taking of photographs, it is well to prepare the basis of a scaled drawing of the room or the area of interest in the investigation This should be done by measuring the distances and dimensions of various objects from fixed points in the area of interest The most satisfactory method of accomplishing this is to arrange to have the county engineer or a qualified civil engineer prepare such scaled drawings

Hatcher[2] points out the possibility of establishing from the location of fired cartridge cases the position in which the gun was held at the instant of firing from the ejection diagrams of repeating or full automatic types of firearms (Fig 64) It is well to point out that all guns of the same make, model and type do not give precisely the same ejection diagrams The position in which fired cartridges may come to rest will depend to some extent upon the pressure developed in the cartridge case at the time of firing, the tension of the recoil spring, and the tightness of the gun parts Of course since fired cartridge cases are cylindrical in form they may roll on flat surfaces or on surfaces which are not level

Preservation of Powder Patterns—When gunshot wounds have been inflicted at close range, powder residues or "tattoo" marks, as they are sometimes called, are left around the point of entrance of the fatal bullet These powder residues may either be on the victim's skin or on his clothing If they are on the clothing, the clothing should be preserved by wrapping in clean paper If they are on the victim's skin, they should be carefully examined with a hand magnifier and then a scaled photograph should be made, including the entire area over which the powder residues exist

[2] Ibid, pp 236–238



EJECTION DIAGRAMS

FIG 64 Location of ejected shells when fired in some of the common types of automatic weapons The arrow indicates the direction the gun was aimed at the time it was fired The dotted circle shows the size and position of the area in which the ejected shells will fall When shells fired from an automatic weapon are found at the scene of the shooting it is possible to establish with fair accuracy the position in which the gun was held at the time gun was discharged This diagram originally appeared on page 237 of General J S Hatcher s excellent treatise *Textbook of Firearms Investigation Identification and Evidence* It is reproduced by courtesy of Brigadier General J S Hatcher and Thomas G Samworth Publisher

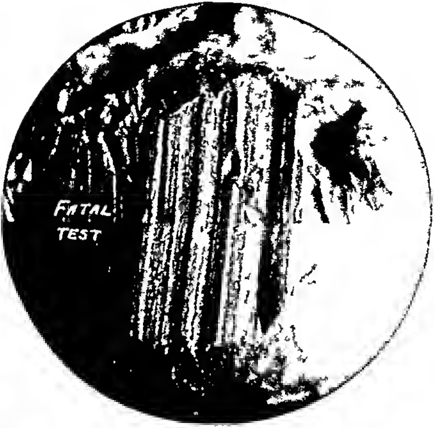


FIG 65 Matched Fatal and Test Bullets A comparison microscope photomicrograph showing the matched position comparing a portion of *test bullet* with a portion of a *fatal bullet* This is the same fatal bullet that was removed from the police officer's body and which is shown in Figure 71 The similarity of the microscopic imperfections transferred in succession to the surface of fatal and test bullets is illustrated in this figure Some of the mutilations resulting from the autopsy surgeon s improper removal of this bullet are indicated on the surface of fatal bullet

In cases of this kind, if the shot is inflicted at a sufficiently close range, partially burned unburned grains or products of combustion of powder may be blown into the victim s skin or clothing In addition, if the interval between the muzzle of a rifled type of firearm and light colored clothing or the skin of the victim, is several inches, a tattoo or powder mark may be left in the form of accented radial smudges which will corre

FIGS 66A 66B and 66C Scaled Powder Pattern Photographs Patterns fired using smokeless powder Remington *Kleanbore ammunition in a 32 Smith & Wesson* revolver The distances indicated were measured from the muzzle of the gun to the test pattern at the time of firing the pattern *It will be observed that a dense* powder pattern (66A) is produced to give radial areas corresponding with 6 00 o clock 9 00 o clock 11 00 o clock 1 00 o clock and 5 00 o clock The weapon used in firing these test patterns was a 32 Smith & Wesson revolver the barrel of which is rifled with five lands and grooves The accentuated radial pattern is caused by the five grooves at muzzle This is helpful in some cases in determining rifling characteristics of the fatal weapon

The scale which has been included in these photographs is a printed paper scale and is obtainable from Central Scientific Company, Chicago Illinois (their Catalog No 70355) It is recommended that each scaled photograph have one of these scales placed in the field of the camera on which some mark of identification has been placed

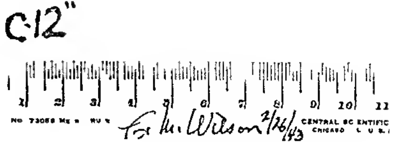


FIG 66C

spond with the number of land and groove impressions of the barrel of the firearm used in firing the fatal bullet (Figure 66A) If this is the case, these marks should be preserved by making scaled photographs of the area of interest (Figures 66A, 66B, 66C)

If a qualified laboratory technician is provided with certain objects, it is possible for him to determine, as the result of firing test shots at test targets at known distances, the interval between the muzzle of a rifled type of firearm and the victim's skin or clothing at the instant the fatal shot was fired The items required by the laboratory are as follows (1) the fatal bullet, (2) if possible, the fatal shell, (3) the fatal weapon, (4) ammunition of the same type as was used in firing the fatal shot, and (5) the clothing of the victim containing the powder burns, or a scaled photograph of the area containing powder residues

In recent years there has been considerable discussion concerning the possible use of the "dermal nitrate" tests which are used to determine whether or not a person has recently discharged a firearm The test is made by coating the back of the fingers and the hand up to about the wrist with paraffin which has been heated to a temperature of approximately 150° F The cast is built up to a thickness of about 1/8 inch and then after it has solidified, is removed from the hand and is treated with Lunge's reagent The presence of small particles containing either nitrates or nitrites will be indicated by a blue reaction of the particle and the Lunge's reagent

When this test is employed, it should be done as soon after the commission of the crime as possible In addition it is suggested that the casts be made of the backs of both the right and left hands The results of this test can of course be affected by contaminations containing nitrates or nitrites or other oxidizing agents from sources other than the products of combustion of gunpowder By making tests on both the right and left hands this gives some measure of a control test since if the suspect had handled material such as fertilizer, firecrackers, etc , we would then expect to find particles giving a positive reaction on both hands It has been the writer's experience that this test is not as reliable as has been reported by some investigators

It is suggested in attempting to locate ammunition of the

same type that, if in the course of the investigation a box of ammunition is recovered which corresponds with the caliber and type of that used in firing the fatal shot, the box and its contents be sent to the laboratory The manufacturers of ammunition stamp on the boxes, usually with a rubber stamp, a lot number If this lot number is available, it is possible, by corresponding with the manufacturer, to ascertain much information of value in this connection which pertains to the particular type of powder used, the type of priming and details of tests run on the components of the ammunition

Another test which has proven to be very useful where dark colored clothing is involved was originally reported by Walker [3] In this test the clothing containing a shot or bullet penetration may contain powder residues but because of the color of the dark clothing in relation to powder residues it is impossible to determine with certainty the density and extent of the powder residues present on the clothing The test involves treating the clothing in the manner suggested by Walker in his paper Since the original article may not be readily available, a portion is reproduced here [3]

> "Ordinary glossy photographic paper is completely desensitized by the usual photographic hypo bath, washed thoroughly and dried It is then immersed in a warm 5 per cent solution of 'C acid for 10 minutes The treated paper is allowed to dry It is believed that this paper may be kept indefinitely, but for the present, at least, it seems advisable to prepare it fresh for each important case and to test a portion of each lot before the following procedure is employed
>
> "A pad of cotton cloth or a towel is laid upon the table, on top of which a piece of the prepared paper is placed face up This must be of sufficient size to accommodate all of the powder residue On top of this, face down, is laid the fabric containing the bullet hole Next are placed a thin layer of dry toweling, a thin layer of toweling slightly moistened with 20 per cent acetic acid and a final thin layer

[3] Walker Joseph T, Chemistry and Legal Medicine Paper read before Massachusetts Medico-Legal Society Feb 3 1937 Reprinted in *New England Journal of Medicine 216* (23) 1024-1027 (June 10 1937)

FIGS 67X, 67Y and 67Z Handarm Powder Residues when Fired in Contact Scaled photographs of "contact" test patterns fired using a .32 Colt automatic pistol and .32 A P smokeless powder ammunition manufactured by Remington Arms Company The three photographs 1/X, 2/Y, and 3/Z are as follows

$\frac{1}{X}$ = the front surface of the test pattern (Fig 67X)

$\frac{2}{Y}$ = the back surface of the test pattern (Fig 67Y)

$\frac{3}{Z}$ = the front of a second card placed immediately behind and in contact with the surface $\frac{2}{Y}$ (Fig 67Z)

The series of three illustrations explain why, when a gun is held in contact with the skin of the victim, there will be an absence of powder residues on the outer surface of the skin and in addition, tears will be produced in the skin of the victim radiating away from entrance penetration The gases and products of combustion following the projectile are prevented from escaping from the muzzle because the muzzle is held in contact with the victim's skin This does not permit them to escape and be distributed over the outer surface of the skin These gases will be forced back under the layers of the skin immediately below the outer surface and into the tissues of the victim As they force their way back under the outer layers of the skin they will tear the outer surface in many cases

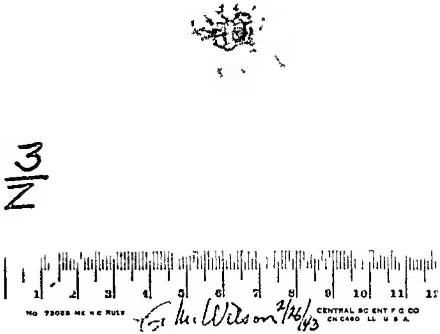


FIG 67Z

of dry toweling The whole pack is then pressed with a warm electric iron for from 5 to 10 minutes The prepared photographic paper when removed is found to have impressed upon it a number of dark red spots which correspond to the position of the partially burned powder grains around the bullet hole This test is sensitive to black and smokeless powder residue, and is insensitive to all other usual chemicals except nitrites

"'C acid' is the common name of the dye, intermediate 2 naphthylamin-4,8 disulfonic acid It may be purchased at a very reasonable price from the Eastman Kodak Company"

In the initial stages of an investigation it is not definitely known whether a suspect will be apprehended at a later time Consequently it cannot be known what the defendant's contention is going to be concerning the facts which resulted in the death of the deceased It is often the case that when a defendant comes to trial he will contend that the shot was fired in self defense If evidence pertaining to powder burns on the victim's skin or clothing is carefully preserved, this will often refute a contention of this kind It is therefore suggested that when products of combustion of gunpowder are found on the victim's skin or clothing, that it be carefully preserved on the assumption that it may later be an important part of the case

In removing clothing from the victim's body in a homicide case, it is well to keep in mind that when it is necessary to cut or tear the clothing this should be done in such a way that the cut or tear does not extend through any bullet or shot column penetrations or powder residues which exist in the clothing Detailed information should be preserved as to the dimensions and general appearance of gunshot entrance and exit wounds

A contact shot in which the muzzle of the gun is held against the victim's head at the instant of firing the fatal shot, in addition to producing a truncated conical perforation of the skull, the apex of which is at the point of penetration and the base being at the point of exit, almost invariably produces jagged tears in the skin around the point of entrance in the face or scalp Such conditions as these should be carefully noted by both the

investigator and the autopsy surgeon In cases of head wounds which have been produced by projectiles having an instrumental velocity in the neighborbood of 1000 feet per second and above, often multiple fractures of the skull will result from the sudden increase in the intracranial pressure produced by the entrance of a high velocity projectile

Firearms Identification—The firearms identification technician, in his examination of exhibits submitted, follows an orderly procedure in tbe examination of a fired bullet, a fired shell, or a suspected weapon It is possible in most instances to determine from a fired bullet or a fired shell certain things concerning the class characteristics of the weapon used in firing the exhibit submitted If the exhibit is a fired bullet, tbe class characteristics may concern the following caliber, type of weapon (semiautomatic, automatic, rifle, revolver, etc), type of bullet, the number, width and direction of twist of rifling impressions of barrel of weapon firing exhibit From this information it is possible for the laboratory technician to provide a list of weapons which are capable of baving fired the fatal bullet [4] This information is obviously of considerable importance to tbe investigator [5]

If a suspected weapon is recovered, the class characteristics of tbe weapon submitted for examination are determined and if it is found that tbe weapon is capable of baving fired the fatal bullet, then a microscopic comparison is made involving the individual characteristics of fatal and test bullets—characteristics peculiar to that particular gun barrel and to no other This examination is made by means of the comparison microscope The magnified images of the surfaces of test and fatal bullets are compared by means of this instrument See Figure 34 If a sufficient number of individual characteristics correspond when comparing fatal bullets with test bullets, it is then possible for the firearms identification technician to render an opinion in

[4] For the information of investigators who are not already familiar with the general acceptance of the findings of a qualified firearms identification laboratory technician it is well to point out that at the present time there are some 16 state supreme courts which have ruled favorably on the question of the admission of expert testimony based on such findings

[5] Inbau, F E Scientific Evidence in Criminal Cases " *Journal of Criminal Law and Criminology 24* 4 pp 825–845

answer to the question, "Did this gun fire this particular bullet?"

It is possible, upon examining a fired cartridge case and a suspected weapon, to determine whether the fired cartridge case was fired in the weapon in question by resorting to a comparison microscope examination of ejector marks, extractor marks, firing pin indentations and breech block markings If a sufficient number of individual characteristics are transferred from the suspected weapon to test shells fired in that weapon and if there is a sufficient correspondence between these individual characteristic markings on the test shell and the evidence shell submitted, it is then possible to determine this with a degree of certainly equal to that when fired bullets are involved[6]

In those cases in which shells have been fired either in autoloading full automatic or repeating types of weapons and have been recovered, it is possible from an examination of the relative positions of ejector marks, extractor marks, breech block markings or individual scars or marks made by the firing pin to determine the possible or probable make, model, and type of weapon which was involved in firing the shell submitted for examination

Judicial Proof —The laboratory technician who is engaged in the practical demonstration of the proof of certain questions of fact which may be submitted to him proceeds to study the cause or combination of causes which could have produced a certain result When he has completed his study, he will, if successful in his examination, have eliminated all possible causes except one, and we may then consider this conclusion as the strongest type of evidence, since the conclusion is reached without fear or prejudice on the part of the person making the examination, and the conclusion may be subjected to critical review by another person similarly qualified

When the results of the laboratory examination bring the qualified technician to a final and conclusive opinion, there need be no discussion as to what the procedure of the investigating agency should be Under certain conditions and for reasons which are not often appreciated by persons not similarly quali

[6] Wilson C M The Identification of Extractor Marks on Fired Shells *Journal of Criminal Law and Criminology 29* 5 (Jan Feb 1939) pp 724–730

fied, the laboratory technician is unable to render a definite, conclusive opinion He may find it necessary to qualify any conclusion reached Any qualified opinion should however be given serious consideration by the interested investigative agency, since it may furnish a strong indication as to that phase of the investigation which should be checked more closely

In answering the question as to how much importance should be attached to the findings of the laboratory technician, we should consider, first the reputation of the laboratory technician as to his willingness and ability to fairly and impartially present the facts second the qualifications of the technician in his particular field of specialized endeavor, and third proof of corroboration of his findings by other phases of the investigation

Our various courts of record have come to recognize the importance which should be attached to certain objective laboratory techniques which when properly conducted, have contributed much in establishing facts upon which an issue has turned

At the present time laboratory techniques applied to the question of judicial proof may be considered to be in the embryonic stage, since the standardization of either the techniques themselves or of instrumentation has only begun Only after the process of standardization of techniques has made further progress can we expect to embark on a program of coordinated research which will result in an extension of the possible applications of laboratory techniques to a point where they are generally accepted by trial and appellate courts and depended upon as the proper method of establishing facts, probabilities or possibilities

The time is not far distant when trial and appellate courts will comment unfavorably on the handling of cases when it is apparent laboratory techniques could have contributed in establishing facts, but those charged with the investigation failed to avail themselves of such techniques in preparing the case for trial

Recovery, Marking, and Preservation of Exhibits—It is important that all investigators realize the fact that in an investigation they are not bound by the same rigid rules of evidence that apply in the court room in so far as the investigation

is concerned—but are free to follow any method which is not frowned upon by the courts and which gives reasonable promise of developing facts, probabilities or possibilities pertinent to the investigation It is, therefore, particularly important that they exhaust every possibility before considering the investigative phase of a case closed In practice it has been observed that in many criminal cases the investigation is continued until the jury has been charged

The laboratory technician is seldom able to actually supervise the recovery, marking for future purposes of identification, preservation, or packing preparatory to shipment of physical evidence which he may subsequently examine in the laboratory He must, in a majority of instances, depend entirely upon the practical field investigator or others to properly recover and preserve those pieces of physical evidence with which he is to work in the laboratory It is therefore of prime importance that a close understanding of their mutual problems be enjoyed by both the field investigator and the laboratory technician Unless this close relationship exists, it is useless to look to a full realization of the potential possibilities offered questions of judicial proof by the combined efforts of investigator and the laboratory technician

It should be pointed out that seldom, if ever, do the efforts of the laboratory technician utilizing almost any type of laboratory technique replace good investigation Laboratory findings should be considered by the investigator, by the prosecuting attorney, and by the court as an adjunct or supplement to an investigation which has been thorough in so far as the subject matter covered is concerned This is true at the present time and undoubtedly the position of investigation and the results of laboratory techniques will never be altered

The decision as to whether a particular exhibit will lend itself to objective laboratory techniques, and thereby result in the development of information pertinent to the investigation at hand, certainly cannot be properly made by a person unfamiliar with the results of the techniques which the laboratory may have to offer The investigator should possess at least a superficial knowledge of the underlying principles of laboratory techniques which may advantageously be applied It is not

to be inferred from this that it is necessary that every field investigator be an accomplished laboratory technician, but it is recommended that every investigator be appraised not of the details of any particular laboratory procedure but first of the conclusions that can be reached if the laboratory technician is supplied with certain specified exhibits, and, second, of the laboratory's recommended procedures relating to the recommended methods of recovery, marking, preservation, and transmission of these exhibits See Figures 74A and B.

When fired bullets are recovered, it is recommended that they be immediately placed in rigid cardboard containers such as pill boxes, and that, in addition, they should be packed in clean absorbent cotton [7] If such a container is not immediately available, it is suggested that recovered fired bullets not be carried in the pocket, with keys, coins and other hard objects, as these objects may mutilate the surface of the bullet which is later to be subjected to a microscope examination. If a cardboard pill box is not readily available, the bullets should be tied in a corner of a handkerchief and placed in the breast pocket of the officer's shirt. This minimizes the possibility of loss or mutilation of fired bullets.

In the following series of illustrations (Figures 65, 68, 69, 70, 71, 72, 73) are photographs of exhibits which have been submitted to the writer for purposes of laboratory examination over a period of time by numerous investigators. This collection of illustrations was made from photographs of the exhibits as they were received in the laboratory and explains why the laboratory technician is sometimes unable to render a definite conclusion because of the mutilation and improper handling of evidence

In Figure 68 are shown four fired lead bullets Apparently the investigator realized that these must be marked in some way so they could be readily identified. He used an ordinary shipping label with a piece of copper wire attached. This he wrapped around the cylindrical portion of the bullet, twisting the two loops of wire together. Not being content with this, he apparently applied a pair of pliers to the loop of the wire, clinching it up so that it cut into the surface of the bullet which contained

[7] Federal Bureau of Investigation, *Firearms Identification*, pp 3–4, 1941, Government Printing Office

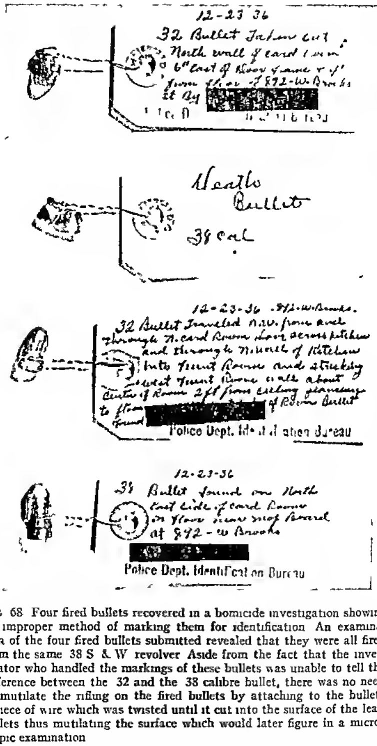


FIG 68 Four fired bullets recovered in a homicide investigation showing an improper method of marking them for identification An examination of the four fired bullets submitted revealed that they were all fired from the same 38 S & W revolver Aside from the fact that the investigator who handled the markings of these bullets was unable to tell the difference between the 32 and the 38 calibre bullet, there was no need to mutilate the rifling on the fired bullets by attaching to the bullets a piece of wire which was twisted until it cut into the surface of the lead bullets thus mutilating the surface which would later figure in a microscopic examination

the rifling. Examination of the tags indicates that this investigator had labeled the four exhibits as follows: "32," "38," "32," and "38." Examination of these four bullets revealed that they were all fired from the same weapon, which was a revolver chambered to fire the .38 S. & W. cartridge. Needless to say that if these exhibits had been produced in court as they were

FIG 69. Improper marking of fatal revolver bullet The fatal bullet removed from the victim's body. The autopsy surgeon marked it for purposes of identification with his initials "LMM" These initials were placed on the cylindrical portion of the bullet which would be expected to contain the rifling marks of the weapon firing it This is the area that was subsequently subjected to a microscopic examination Marking the bullet in this manner is unnecessary and may prevent an identification from being made.

originally submitted to the laboratory, the defense counsel would have given the well-meaning but misguided investigator a bad time on the stand.

Figure 69 is a photograph of a fatal bullet as it was received in the laboratory. The surgeon who performed the postmortem examination of the victim's body in this murder case marked the bullet, as can be seen from the illustration, with his initials "LMM." This apparently was done with a scriber or some sharp instrument and the initials "LMM" were placed on the side

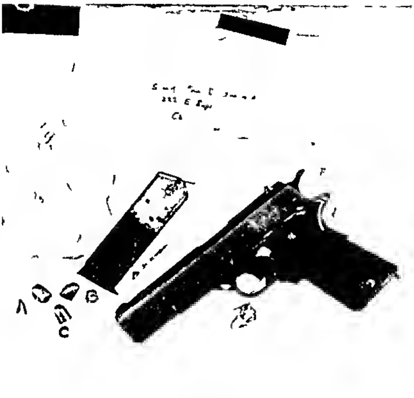


FIG 70 Improper shipment and marking of evidence During the course of an investigation of a homicide case which involved the killing of a police officer a 45 automatic pistol the clip and the three fatal bullets labeled A B and C were recovered These were placed in the brown manila envelope shown which was sealed and postage was put on the package and it was then sent through the mail No record was kept of the serial number of the automatic pistol nor had the three fatal bullets been marked for purposes of identification As might be expected the package was intercepted by the post office inspectors There was no way of ascertaining through how many people s hands it went before it was received by the laboratory technician Fortunately the three fired bullets submitted did not match with this gun It would have been a comparatively simple matter for the defense counsel to impeach the evidence if an identification had been made Besides jeopardizing the case the United States Postal Regulations were flagrantly violated

of the cylindrical portion of the bullet which later figured in a microscopic examination of the fatal bullet A portion of the laboratory technician's marking can be seen near the tip of the

bullet. This latter method is the proper method of marking such exhibits for purposes of identification.

In Figure 70 is shown a .45 automatic pistol, clip and three fatal bullets, which have been labeled "A," "B," and "C." These exhibits were sent to the laboratory in a brown manila envelope, which is included in the illustration. The gun, the clip and the three unmarked fatal bullets were placed in the envelope by an assistant state's attorney, the postage was placed on the envelope and it was then dropped in the mail box. No record was kept of the serial number of the gun, nor were the fatal bullets marked for purposes of identification. As might be expected, the package was opened by the post office inspectors, who delivered the evidence to the author. It should be pointed out that it is contrary to the postal regulations to ship either explosive substances or firearms through the mails, except under certain conditions as provided by the postal regulations.

It is suggested that in the event the fatal bullets, "A," "B," and "C," had matched up with the .45 automatic pistol submitted for examination, it would not have been difficult for opposing counsel to impeach the evidence, fatal bullets "A," "B," and "C," and the .45 automatic pistol.

In Figure 71 is shown a photograph of a fatal bullet which was removed from a police officer's body. In this particular case the police officer was dead and there was nothing that could be done for him. In probing for the bullet the autopsy surgeon apparently located the bullet; the mistake that he made was in probing with a steel chisel. The marks on the surface of this fatal bullet were produced by the probe used. This is the same fatal bullet which is shown in Figure 65 in a "matched" position with the test bullet fired from the perpetrator's gun. It is suggested that a minimum amount of probing be done for fatal bullets and that, when possible, the bullet not be handled with a hemostat but preferably with the fingers or tweezers, over the tips of which have been placed two pieces of rubber tubing. This will minimize the mutilation of the bullet.

In Figure 72 is shown a photograph of a fatal bullet which passed through the victim's body and lodged in the wall. A well-meaning police officer attempted to remove the bullet by prob-

FIG 71 Unnecessary mutilation of fatal bullet removed from police officer's body Since the officer had died prior to the time the bullet was removed, nothing further could be done for him It was unnecessary for the autopsy surgeon to probe for the bullet with a steel chisel, thus seriously mutilating the surface of the fatal bullet as indicated in the above illustration Through no fault of the autopsy surgeon it was possible to make an identification of this fatal bullet appearing here with test bullets fired from the weapon later recovered in the investigation of this case The identification which was made is illustrated in Figure 65

It is suggested that in the removal of the bullet from the body of the victim who is dead, care be exercised so as not to mutilate the fatal bullet

ing for it with an ice pick The resulting mutilation is quite apparent in the illustration In cases of this kind it is suggested

FIG 72 Improper removal of fired bullet from wall Fired bullet recovered in the investigation of a homicide which was recovered from the wall by the investigating officers Instead of cutting around the bullet the officers attempted to locate the bullet by probing with an ice pick The damage done to the fatal bullet is clearly illustrated This practice of locating fired bullets in walls is not recommended

that a bole be chiseled in the wall around the point of entrance of the bullet so that the bullet can be removed without mutilating it

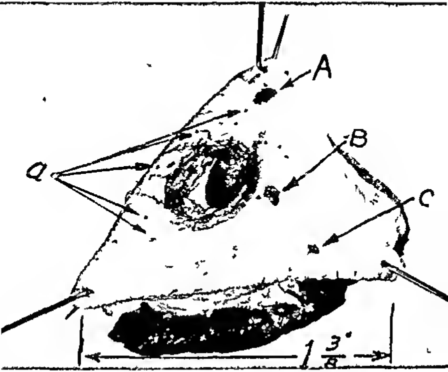


FIG 73 Improper preservation of powder pattern on victim's skin Piece of flesh from the victim in a homicide investigation in which the question of murder or suicide later became the turning point of the ease At the time the body of the victim was posted the autopsy surgeon removed a triangular piece of tissue from the victim's left breast approximately 1⅜ inches on each side immediately adjacent to the bullet hole This was sent to the Laboratory together with the suspected weapon and the question was submitted "At what distance was the fatal weapon held at the time the fatal shot was fired? In this illustration A, B and C are three pieces of powder which had burned into the tissue of the victim The points marked "a" are smaller pieces of powder There were undoubtedly other particles of powder on the victim's skin which, of course, were not available to the laboratory technician It was unnecessary to mutilate the victim's body in this manner A far more satisfactory method would have been to make a scaled photograph of the area including in the field of the camera all discolorations due to powder particles and blackening around the point of entrance of the bullet Obviously the determination sought in this case was not possible

In Figure 73 is shown a triangular piece of flesh measuring approximately 1⅜" on each side, which was cut from the left breast of the victim in a homicide investigation This piece of

skin was placed in a shaving cream jar and sent to the laboratory. Needless to say the piece of skin shown in the illustration was of little or no value in determining the interval between the muzzle of the gun and the victim's skin at the time the fatal shot was fired. This later became an important question in the case, but the evidence had not been properly preserved and, in addition, there seems to have been no justification for the mutilation of the victim's body. The evidence could have been preserved without mutilating the victim's body, if a scaled photograph had been made in the manner suggested previously

In Figure 74, Table I, have been set up the various types of exhibits that may be encountered by the investigator, the possible laboratory determinations and the exhibits which will be required by the laboratory technician

In Figure 74, Table II, have been set up the instructions for handling, marking and shipping of firearms evidence The contents of these tables include the essential information which the autopsy surgeon or the investigator should have in order to permit them to properly mark, handle and ship evidence to a qualified laboratory technician.

In Figure 75 is shown a diagrammatic representation of the recommended method of marking fired bullets and fired or loaded shells or cartridge cases As indicated in the illustration the cartridge cases, whether loaded or fired, should be marked with either the investigator's initials or some appropriate mark of identification, preferably not with an "X," since this is often used by persons marking evidence.

In Figure 76 is illustrated a diagrammatic representation of the recommended method of marking revolvers for purposes of identification It is suggested that the mark of identification be placed on the frame or on the barrel It is further suggested that the mark of identification not be placed on the stocks or some part of the gun which can readily be removed or substituted. The reason for this is apparent when it is pointed out that the stocks on a particular make, model and type of gun are interchangeable. Thus it would be possible to change the stocks and consequently the mark of identification if the mark of identification is placed on some part that can readily be removed or changed.

TABLE I—FIREARMS IDENTIFICATION

EXHIBIT	POSSIBLE LABORATORY DETERMINATION	REQUIRED BY LABORATORY	
A FIRED BULLET	Make, caliber, type of firearms from which it could have been discharged, type of propellant used in firing, name of maker and maker's designation as to type, caliber, etc.	Fired Bullet.	
B FIRED CARTRIDGE CASE	Make, caliber, type of firearm in which it could have been fired type of propellant used in firing, name of maker and maker's designation as to type, caliber, etc.	Fired cartridge case.	
C TWO OR MORE FIRED BULLETS	In addition to A, whether both were fired from same firearm.	Two fired bullets.	
D TWO OR MORE FIRED CARTRIDGE CASES	In addition to B, whether both were fired from the same firearm.	Two fired cartridge cases.	
E FIRED BULLET AND SUSPECTED FIREARM	In addition to A above, whether bullet was fired from suspected firearm.	Suspected firearm. Fired bullet.	Suspected firearm. Test bullets fired from suspected firearm ①
F FIRED CARTRIDGE CASE AND SUSPECTED FIREARM	In addition to B above, whether cartridge case was fired in suspected firearm.	Suspected firearm. Fired cartridge case.	Suspected firearm. Test shells fired in suspected firearm ①
G A FIREARM, AMMUNITION, AND A SCALED PHOTOGRAPH OF POWDER OR SHOT PATTERN	*Approximate distance at which shot was discharged.*	*(Scaled Photographs)* (See Note 2)	
H SHOT PELLETS AND WADS	Size of shot, and gauge designation of arm firing wads.	Shot pellets and/or shot wads.	

① It is to be preferred to submit firearm in question. If, however, this is impractical, fired test shells, cartridge cases, or bullets (at least 3) can be submitted, using same make and type of load as questioned or "fatal" bullet, shell, or cartridge case.

② Rifled firearms – Firearm fired bullet, fired cartridge case, and any loaded cartridges and ammunition manufacturers' boxes recovered.
Smooth-bore firearms – Firearm, fired shell, wads, fired pellets and any loaded shot shells and ammunition manufacturers' boxes recovered in the investigation.

TABLE II—INSTRUCTIONS FOR HANDLING, MARKING, AND SHIPPING FIREARMS EVIDENCE

EXHIBIT	GENERAL INSTRUCTIONS	DESCRIPTIVE RECORD TO BE KEPT BY SENDER (Note 1)	RECOMMENDED METHOD OF MARKING FOR IDENTIFICATION	INSTRUCTIONS FOR PACKING FOR SHIPMENT	SHIP VIA
A FIREARMS	Unload. Do not clean. Do not operate mechanism except to unload. Remove clip or magazine	A record of make, model, type, caliber or gauge designation, serial and lot number should be retained by person recovering	Scratch initial or mark of identification on side of frame, receiver, barrel, etc., but on stocks or part that can be readily removed	Wrap in waste or clean rags. Ship in wooden box (See Note 2)	Express only (Note 5)
B FIRED BULLETS	Every precaution should be taken to prevent abrading or mutilating exterior in any way. Do not wash or clean	Assumed caliber. Notes as to marks of identification. Description of any distinctive features	Scratch one initial or mark of identification on base or nose of bullet (Note 3). If more than one bullet recovered, label A, B, C, etc., keeping notes as to source of each	Wrap in clean absorbent cotton and place in cardboard pill box or rigid container. Do not put in envelope. Indicate on box source of bullet	Registered mail or express (See Note 6)
C FIRED METALLIC CARTRIDGE CASES	Do not mar, mutilate, scratch or pick head of shell. If recovered in a revolver cylinder, mark chambers to correspond with shell designations. Note 7	Notes as to mark of identification used. Head designation of maker. Accurate scale drawing or photograph showing relative position of shells when recovered. Transmit this information to laboratory technician. Note 7	Scratch one initial or mark of identification near mouth of shell, preferably inside mouth. Do not scratch, mark or mutilate head or rear portion of cartridge case	Roll individually in paper. Wrap in cotton or clean rags. Pack in cardboard box	Registered mail or express
D FIRED PAPER SHOT SHELLS	Do not mar, mutilate, scratch or pick head of shell	Notes as to mark of identification used. Head designation of maker. Accurate scale drawing showing relative position of shells when recovered. Transmit this information to laboratory technician. Note 7	With ink or indelible pencil mark inside at mouth of shell. Do not scratch, nick or mutilate brass head of shell	Roll individually in paper. Wrap in cotton or clean rags. Pack in cardboard box	Registered mail or express
E SHOT PELLETS	Place in glass vial, test tube or cardboard pill box. Remove as many as possible. Pack with cotton. Note 6	Source and position of recovered pellets. Number sent to laboratory. Notes on marks of identification used	Seal container, marking same with mark of identification on gummed label, seal or via sealing wax seal (Note 6)	Use cardboard shipping container	Registered mail or express
F SHOT WADS	Place in cardboard pill box	Source of wads recovered. Note on marks of identification used	Using ink or indelible pencil insert the mark of identification or seal container with gummed label bearing [illegible] for ident. or sealing wax seal (Note 6)	Use cardboard shipping container	Registered mail or express
G LOADED SHELLS OR CARTRIDGES	Place in cardboard or wooden container. If ammunition maker's box recovered, include that in shipment, marking for identification	Where found. Head designation of maker. Notes on marks of identification used	Brass cartridges – Scratch mark on side of case. Paper shot shells – Use ink or indelible pencil. Mark side of shell	Ship in wooden container	Express only (See Note 5)
H SHOT OR POWDER PATTERNS	Make scaled photograph	Photographic data (See Note 4)	Mark margin of negative (out of field of camera) (See Note 4)	Pack so as to protect against scratching, creasing, bending or cracking	Registered mail or express

1. Notes should be made covering
   (a) Date, place, time and relative position of exhibit at time recovered
   (b) Particular method employed in marking for future purposes of identification
2. Requirements of American Railway Express call for shipment of firearms in wooden containers
3. Since examination of base of fired bullet may disclose type of propellant used in firing, care should be exercised so as not to disturb powder residues on base.
4. Keep record of date and time picture taken, make and type of camera used, name and number of lens used, stop, exposure, lens-to-object distance, type of emulsion and notes on lighting used
5. Postal regulations prohibit shipment of explosive substances or objects such as firearms through mail
6. Wrap securely and seal package with sealing wax, placing identifiable mark in soft sealing wax
7. Make sketch of position of shells recovered. Indicate relative positions in feet and inches

FIG. 74

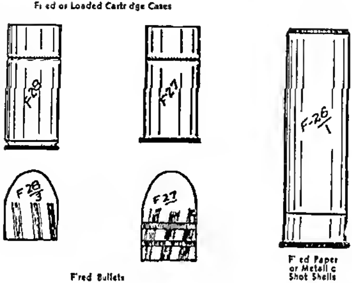


FIG 75 Proper marking of fired bullets and shells Scratch mark of identification in location shown If more than one recovered use distinguishing marks so that source of each can be established It is suggested that X not be used as majority of persons use that mark of identification

FIG 76 Proper marking of revolvers, automatic pistols or handguns Scratch mark of identification on frame, slide of barrel or some part not readily removed Do not place mark on stocks as they can be changed

In Figure 77 is illustrated the same general procedure in the matter of marking rifles, shotguns or automatic types of weapons such as the Thompson or the Reising sub machine guns The recommended procedures referred to in marking revolvers should also be followed in marking exhibits of this type, namely, the marks of identification should be placed on the

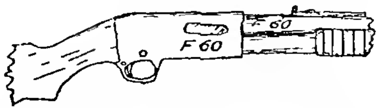


Fig 77 Rifles or shotguns Scratch mark of identification on frame receiver or barrel or some part not readily removed Do not place mark on stocks as they can be changed

barrel or frame or some other part of the gun which cannot readily be removed or substituted

If automatic pistols are to be marked for identification it is suggested that they be marked on the barrel or on the frame of the weapon, preferably both, since it is possible to exchange parts of certain types of automatic pistols

In cases in which revolvers containing either loaded cartridges or fired shells are recovered it is suggested that a diagram be made of the rear face of the cylinder of the weapon as is illustrated in Figure 78 In this illustration will be seen a lot number This would serve as a reference point so that if the loaded or fired cartridge cases are marked in relation to this reference point, it would then be possible to determine from which particular chamber position each of the six cartridges or cartridge cases were found This might be important, and has been in some cases As an illustration, as indicated in the diagram, the rotation of the cylinder is in a clockwise direction because of the function of the design of this particular gun Consequently, Position No 5 was the last chamber fired

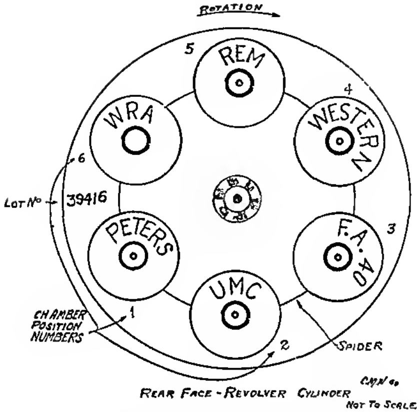


FIG 78 Marking of revolver chamber positions loaded cartridges and fired cartridge cases recovered in revolvers In the diagram above it can be seen that if the chamber position corresponding with the loaded cartridges and fired cartridge cases as they were recovered in the gun are correctly marked, the relative positions of cartridges can be correctly preserved with respect to the direction of rotation of the cylinder This is a design feature of a particular gun thus the examination of the gun might reveal that the positions Nos 1 2 3 and 4 had been fired at some previous time whereas position No 5 was recently fired and if the fatal bullet in a hypothetical case corresponded with the Remington ammunition this might be important in establishing the facts It is suggested that the chamber position numbers correspond with the markings on the loaded cartridges or fired cartridge cases recovered in the chambers of a revolver

CHAPTER 9

Homicide Due to Cutting and Stabbing Wounds

GENERAL CONSIDERATIONS

WHEN THE officer first comes upon the scene of a bomicide where death has apparently been due to stabbing or cutting wounds, several questions immediately present themselves:

1. Were the wounds made by a knife, or were tbey the result of some other force? It is not always easy, *and often it is difficult*, to *decide* at first glance, what instrument was used to make what appears to be a wound made by stabbing Gunshot wounds may resemble knife slashes and penetrating stab wounds may be mistaken for bullet holes *Particularly if* a bullet strikes *at an angle* a surface of the body such as the head or shoulder, the resulting gasb in the skin often greatly resembles the slash of a knife. When a person falls, striking his head violently on a smooth surface, such as a hard floor or ice, lacerations of the scalp may closely resemble knife wounds.

2 Where and in what manner were the knife wounds administered? Was the victim attacked from the front or rear? Did the victim put up any defense? How long did he live after receiving the thrust that killed him?

3. What sort of a knife or cutting edge was it that inflicted the wounds? *The type of wound* made by a knife-thrust will depend upon three general factors:

(a) *The characteristics of the knife· its shape, sharpness of* point, the keenness of the edge and whether it is single, or double edged

(b) The manner in which it is thrust into the hody. It is seldom that a knife is thrust directly at a right angle into the hody and pulled straight out again, so that

FIG 79 Multiple *stab wounds* with considerable cutting There were also several knife wounds of the head and scalp

practically every stab wound is a combination of stabbing and cutting Because of this circumstance at the point of entry the wound will usually be larger than the width of the knife

(c) The location of the knife wound in the body The skin has considerable elasticity and the amount of stretch depends upon its location on the body

Those areas in which the elastic fibers are parallel are known as cleavage planes Consequently a knife which is forced through the skin parallel to the cleavage planes and then withdrawn will leave a wound which is closed or nearly so while if it is inserted across the cleavage planes it will leave a skin would which is gapping wide

Generally speaking when a homicidal attack is made with a knife there are a great variety of wounds with variations in

FIG 80: Fatal stab wound made across the cleavage planes of the skin causing it to spread open Had the knife thrust been at *right angles* to that shown, the gapping would have been slight. (Courtesy of G Russell Carrier.)

depth, width and amount of bleeding. To get an accurate knowledge of the type of knife which made the cut, it is necessary to carefully examine all of the wounds and select the one which most nearly indicates a direct in-and-out thrust. *In considering deaths from stabbing and cutting wounds, it is well to remember that death is seldom accidental, but almost always homicidal or suicidal.* There are, of course, exceptions to this general rule.

FIG 81 Stab wound of neck Apparently there was some cutting in withdrawing the knife (Courtesy of C W Muehlberger)

A common accident in barns is death due to being impaled upon a pitchfork when sliding out of a haymow I know of one instance in which a woman left a needle sticking in the pillow When she retired that night the needle penetrated the back of the neck entering the spinal cord and caused death Accidents such as these are uncommon but their possibility must never be forgotten by the investigator

FIG 82 Fatal stab wound made by a direct in and out thrust Note that size of the wound appears to be actually less in width than the width of the knife (Courtesy of the Police Department of South Haven Michigan)

Characteristics of Suicide Wounds.—In ancient times stabbing and falling on one's sword were common methods of suicide; at present suicide by stabbing is a rare occurrence. When a knife or other sharp instrument has been used, suicide is usually accomplished by cutting wounds

By far the most common method of suicide is cutting the throat with a razor, although in recent years this practice is not as common as in previous times. This is probably due to the fact that most people now use safety razors or electrical shaving devices, hence it is usually elderly people who resort to cutting the throat with a straight edge razor. In these cases, the razor is grasped firmly in the right hand, the incision is started below the left ear and brought under the chin to the right side. Strangely enough, although bleeding may be profuse, the suicide attempt is not always successful, and ***unless the cut has been deep enough to sever the deep arteries in the neck,*** the wound may be treated so that the person recovers.

FIG 83 Multiple stab wounds of neck and chest A large number of in and out thrusts in a comparatively small area indicates that the victim was not struggling or resisting when they were made (Courtesy of C W Muehlberger)

If one carefully observes the wound at the point of origin, he may frequently see one or more superficial cuts an inch or so long These are known as ***hesitation marks*** and are simply an indication that the person first tried out the edge of the razor on his skin before he got up his nerve to make the fatal gash. The cutting, if made deep enough to cause death, will almost always cut across and into the larynx or the windpipe; frequently a considerable amount of blood will actually pour into the windpipe. When death follows from cutting the throat, the knife or

razor will frequently be found tightly clenched in the hand of the dead person When this occurs it is almost absolute evidence of suicide It is not at all uncommon for persons to attempt suicide by cutting the wrists or ankles with safety razor blades broken glass, pieces of tin or other sharp objects This most often happens when a person is confined in jail and finds no better cutting instrument available These attempts are not often successful for several reasons The arteries in the wrist are quite well protected by bones and strong tough tendons therefore it is difficult to sever large enough blood vessels to cause death within a short time In addition, when hemorrhage takes place the body automatically protects itself from bleeding to death by a lowering of the blood pressure As the blood pressure continues to fall, the bleeding becomes slower and slower until clotting takes place and this clotting stops the bleeding

FIG 84 *Hesitation marks* on the neck The razor edge was drawn over the skin several times before the fatal slash was made Evidence of hesitation is also sometimes seen in other forms of suicide (See *hesitation shots* in Chapter 6) From Harvey Little John s *Forensic Medicine* Courtesy of J and A Churchill London

While it is generally true that suicide is usually accomplished by cutting persons will occasionally stab themselves to death in an unusual manner Pins ice picks and similar instruments may be used for this purpose Recently I saw the body of a man who had stabbed himself to death by straightening out an ordinary safety pin and repeatedly plunging it into his chest over his heart A few of the pricks had penetrated the lower end of his heart and produced enough bleeding to cause his death

When a stabbing or cutting wound has been suicidally inflicted the body is generally found at the point where the act

took place whereas in homicidal deaths the victim in his struggle to escape may run over a considerable area leaving traces of blood as he goes

Characteristics of Homicide Wounds—Unless a person is asleep or is otherwise defenseless it is difficult to kill him with cutting wounds alone Consequently homicide is usually accomplished by stabbing although there may be a large amount

FIG 85 *Defense wounds* of the hand These were caused by the victim grasping the knife and then having it wrenched away *Defense wounds* are also often found on the palms of the hands and the outer surfaces of the forearms due to the victim raising his arms to protect his face (Courtesy of Ray Sullivan)

of cutting in the process This type of murder is more common among southern Europeans than among other nationalities If the victim has had an opportunity to defend himself there will be blood stains scattered over a considerable area The amount of defense offered can usually be determined by examining the palms of the hands and the forearms A person defending himself instinctively throws his left forearm up to protect his face and deep gashes will generally be found across the arms The victim will frequently grasp the knife in his hand only to have it pulled away from him leaving deep gashes in the palm or the under surface of the fingers The wounds which cause death will most frequently be located in the neck or the upper part of the chest

It is important to remember that the skull is occasionally the site of a stab wound A pocket knife ice pick or any similar pointed instrument may easily be plunged through the skull into the brain The lethal instrument may then break off at the outer surface of the skull leaving a small scalp wound as the only evidence of the attack This small wound has gone un recognized in several important cases judging from the number of cases of this kind discovered by accident It seems likely that many people have been murdered by this means and their deaths attributed to natural causes

Fig 86 Deep cutting wound of the neck made with a butcher knife

EXAMINATION OF THE SCENE OF THE CRIME

When the officer arrives upon the scene of a crime where death was due to stabbing or cutting wounds, he should carefully recall and follow all of the possible details of procedure enumer ated in previous chapters, such as recording the time of his arrival photographing the body from all angles taking meas urements searching for fingerprints, taking statements from witnesses etc If a knife which is suspected of being the one used is found the greatest care should be used when handling it so as not to destroy fingerprints, blood stains, hair, shreds of

clothing or other evidence *Do not pick up the knife with your hand* After it has been photographed in its original position, use a pencil or similar object to place it in a clean paper bag It may then be taken to the laboratory for further examination

Examination of the Body —Before disturbing the body, note these matters down in writing and by photography

1 The exact position of the body with relation to other physical objects in the room, such as doors, windows, stoves or furniture

2 The clothing on the body Indicate whether it is torn, buttons missing, etc

3 Record particularly the position of the hands and whether or not they are holding knives or other objects

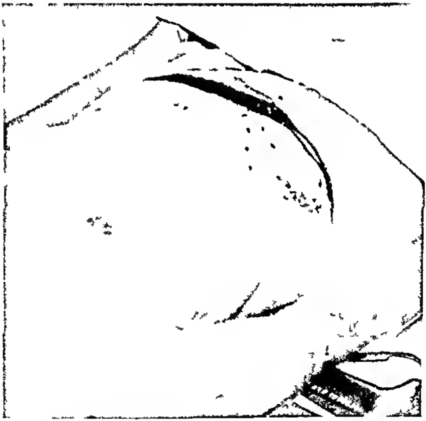


Fig 87 Mutilating wound on the abdomen of the same body as shown in Figure 86 Murder in connection with attempted sexual assault (Figures 86 and 87 Courtesy of the Police Department of Kalamazoo Michigan)

4. Note the general character of the wounds, indicating particularly:

(a) Their location on the body.
(b) A description of the wounds, viz., stabbing or cutting wounds or both.
(c) The presence or absence of defense wounds which, as

FIG. 88. Wounds inflicted with an axe. The deep gash on the left side of the neck was made with a jack knife. (Courtesy of the Police Department of Kalamazoo, Michigan.)

stated before, are slashes on the outer parts of the forearms and on the palms of the hands and fingers.
(d) The extent of bleeding. This is important because it gives some indication as to how long the person lived after the attack. If death takes place quickly, the amount of external bleeding will not be as great as when the person has survived for some time.
(e) The condition of the blood. This will give some indication as to how long the person has been dead. (See Chapter 4 on the examination of blood stains.)
(f) Observations obtained from rolling the body over and examining the undersurfaces.

FIG 89 Fatal stab wounds made with an ice pick At first the victim did not appear to be seriously injured and was taken to a hospital where the dressings were put on the wounds He was then taken to jail and when put into a cell, he dropped dead Death was due to hemorrhage of the lungs (Courtesy of G Russell Carner)

Procedure at the morgue is the same as described in Chapter 7 on gunshot wounds

MEDICAL NOTES ON THE AUTOPSY

1 Photograph the ***unclothed body*** so as to show clearly the character of the wounds

2 Unless suicide can be definitely established, it is wise to do a complete autopsy

3 If a sex crime is suspected in connection with a murder examine the sex organs as outlined in Chapter 18

4 Examine the stomach contents so as to determine the lapse of time since the last meal was eaten Also determine if possible, the food eaten at the last meal

FIG 90 Suicide by stabbing with a *safety pin* The pathologist is holding the heart and at the point of the knife is seen an area of hemorrhage The victim had plunged the safety pin (held in the hand of the assistant) through the chest wall several times (Courtesy of Ray Sullivan)

5 Describe carefully all wounds and measure them with a tape

6 Try to determine which particular wound caused death and how death resulted Death from stabbing wounds may result in a variety of ways For instance, a knife may be plunged directly through the skull into the brain, or it may sever a large blood vessel in the chest and cause death from internal bleeding Recently I examined a body where there were four penetrating knife wounds in the chest In that particular case the blood had slowly oozed into the lower part of the windpipe, where it formed a large clot and the person had actually smothered

7 As far as possible try to determine accurately *the depth of penetration* of the stab wounds This depth is sometimes very difficult to measure, particularly when the wounds have been in the lungs, due to the fact that at the time of autopsy, the

lungs have collapsed One of the chief reasons for trying to determine the depth and size of the stab wounds is that it is possible to get an idea of the shape and size of the knife When there are several knife wounds, care must be used in selecting the particular wound which has the least cutting element involved but most nearly represents a direct in and out thrust

8 By a careful examination try to determine whether the knife was sharp or dull The *cutting wounds* will give a better indication of this than the stab wounds In my experience the character of the defense wounds on the forearms and hands give the best indication as to the *sharpness* of the knife Also determine, if possible, whether the knife was single or double edged In areas largely populated by Italians, Syrians and Sicilians the stiletto is still used, but it is rarely encountered in other districts It is not easy to determine whether a single or double edge knife was employed However, if a wound can be found made by a direct in and out thrust, a close examination of the edges of the wound may reveal which type of knife was used

9 Knowing the depth of the wound and the skin dimensions, try to estimate as nearly as possible the general size and shape of the weapon used

10 From the location of the wounds and their character, it is often possible to tell whether the attack was made from the front or back and the manner in which the fatal wound was inflicted

11 From the number and character of the wounds try to determine whether the victim put up a defense and how long the attack lasted

POSTMORTEM DISMEMBERMENT AND MUTILATION

Occasionally a murderer will try to dispose of the body of a victim by attempting to destroy its identity in one way or another One of the methods used is to cut the body up into sections and dispose of the pieces separately In one of the most celebrated murders in American history, that of Dr Parkman by Dr Webster which occurred in Boston in 1849, that method was employed In the celebrated Ruxton case in England in

1935, the bodies of two women were cut into small sections and thrown into streams and other out of the-way places over a large area

The extent to which crimes of this type can be solved depends largely upon the portions of the body which can be recovered In the Ruxton case, although many of the parts were missing, it was possible to identify the parts as belonging to two different bodies The sex, age, and height were later determined Finally,

FIG 91 Dismemberment murder In this case the body was cut into several sections and scattered over the countryside Identification of the remains is often exceedingly difficult but some of the most ingenious work in legal medicine has been done on such cases (See *Medico Legal Aspects of the Ruxton Case* by Glaister and Brash, William Wood and Company, Baltimore, 1937)

a positive identification was possible From closely examining the cuts *at the point of dismemberment*, it is usually possible to tell whether it is the work of an amateur or a person with considerable anatomical knowledge X ray examination of the bones may give a good indication as to *the age* of the victim If one is so fortunate as to obtain the head, an examination of the teeth and other parts may help to lead to identification The procedure and the amount of information that can be obtained depends entirely upon the parts of the body recovered in each individual case, but as in the Ruxton case and the Webster case, if all the facilities of the scientific laboratory are brought to bear, sometimes remarkable results may be obtained

CHAPTER 10

Deaths Due to Asphyxia

ASPHYXIA IS a state of collapse due to a deficiency of oxygen in the red blood cells. To understand what takes place in deaths from asphyxia, it is necessary to have some knowledge of the physiology of breathing and the function of oxygen in the body.

The tissues of the body demand a constant supply of oxygen just as a flame requires oxygen to keep it burning The tissues receive their oxygen supply from the blood stream, and the particular vehicle which transports the oxygen to the tissues is the red blood cell. The red blood cells are minute, disc-like plates and a small drop of blood, only slightly larger than a BB shot, will contain about five million red blood cells The oxygen is transported by the red blood cells in combination with a chemical known as hemoglobin, a substance which gives the blood its characteristic color. When oxygen unites with hemoglobin, bright red oxybemoglobin is formed

When the red blood cell reaches the particular tissue for which it is destined, it gives up the oxygen it carries, and then takes on a particle of carbon dioxide which is a product of the combustion that is going on constantly in the tissues Carbon dioxide, in combination with hemoglobin, turns the red blood cell to a very dark red color and carries it back through the veins to the heart and then to the lungs When the blood reaches the lungs, it passes through the very thin walls of the air cells and here it gives off its carbon dioxide which is exhaled. Again the blood takes on a load of oxygen, returns to its original bright red color and starts on another round-trip to the tissues. Thus, it can be seen that anything which prevents the red blood cell from taking on its supply of oxygen to carry to the tissues of the living body will bring about a state of asphyxia.

The constant transportation of oxygen from the air in the

lungs to the tissues may be interrupted in a great many ways Anything which prevents the free passage of air into the lungs may cause asphyxia, such as a foreign body in the windpipe or compression of the windpipe by strangulation or hanging Certain poisons, such as carbon monoxide, may prevent the red blood cells from taking on their load of oxygen in the lungs and bring about the same result—a lack of oxygen in the tissues Without oxygen, the tissues cannot live, in fact, some of the areas of the brain are so dependent upon an adequate oxygen supply that they will be destroyed in a very few minutes if oxygen is not available

In this connection, it might be said that the ultimate cause of death is usually the same, namely, a lack of oxygen in the tissues and particularly in the brain It makes no difference what the obvious cause of death might be—pneumonia, typhoid fever, gunshot wounds, poisoning or almost anything that can be imagined The thing that really causes death is the failure of the oxygen supply to reach the body tissues, therefore these various causes of death are simply different mechanisms for bringing about that failure It can thus be seen that asphyxia is a broad subject covering a great variety of different situations and is one of the most important conditions met with in homicide investigation

ASPHYXIA DUE TO DISEASE

Asphyxia may cause death in many diseases in which there is a mechanical interference with the air passages Tumors may cause pressure on the windpipe and, occasionally, the thyroid gland may grow to a size sufficient to block the passage of air to the lungs This gland, which is situated in the front part of the neck over the windpipe, is somewhat the shape of a large butterfly While the gland may become exceedingly large in the neck, it does not often cause compression of the windpipe in this region, because it tends to bulge forward However, in some cases the thyroid will grow down behind the breast bone into the same general region occupied by the thymus and, due to the fact that the breast bone cannot be pressed forward, compression of the windpipe may result Other tumors, such as cancer, may involve the back of the throat, larynx, or other structures

of the neck and plug the air passage from the inside or compress it from the outside

Any infection or disease which will cause swelling of the larynx or the back of the throat may shut off the passage of air to and from the lungs to such an extent that death results

Before diphtheria was brought under its present state of control, it was a very common cause of death The disease caused a membrane to form in the back of the throat which sometimes extended down into the larynx so that a great deal of swelling of these tissues took place This would progress until the child was unable to get air into his lungs and would become very blue Death was the result unless the obstruction was relieved by making an opening into the windpipe or inserting a metal tube in the larynx to keep the air space open

Occasionally an infection which is called a retropharyngeal abscess will cause the development of a collection of pus in the back part of the throat This abscess may become so large as to press forward and block the passage of air into the lungs

ACCIDENTAL CAUSES OF ASPHYXIA

The most common cause of accidental asphyxia is a foreign body becoming lodged in the back of the throat or windpipe A particle of food, such as meat, may accidentally become sucked into the windpipe and cause a complete blockage Usually the body is able to expel such a foreign body by a violent cough, but occasionally this is unsuccessful, and unconsciousness and death will follow rapidly Numerous articles which children handle—whistles, peanuts, buttons—may be drawn into the windpipe and not infrequently go clear down into the bronchi which are the terminal branches of the windpipe in the lungs These may not produce complete blockage of air so that the person may live for several days under such circumstances however, infection is apt to be set up around the foreign body and death results unless it is extracted Some ingenious instruments of modern surgery have been devised for this purpose, and with them many foreign bodies, such as tacks, safety pins, coins and chickens bones, can be extracted through the mouth by an expert

Children are not the only people to whom these accidents happen Adults likewise get all sorts of foreign bodies into their windpipes even false teeth *When a person is unconscious from any cause, complete relaxation of the muscles permits the tongue to drop back into the throat in such a position that breathing is seriously obstructed* Unless a person under a general anesthetic is carefully watched this is apt to occur

SMOTHERING

Smothering occurs when anything prevents air from entering the nose and mouth This may happen accidentally as when a person becomes buried in a grain bin or a gravel pit

Death by smothering is a common diagnosis applied to a situation when an infant or small child is found dead in its crib The mother may put the child to bed believing it to be in good health or at most suffering from a slight cold It is usual that there is no outcry or other symptom of distress and yet in the morning the child is found dead For want of some better diagnosis death is attributed to asphyxia and the explanation made that the baby got its face buried in a pillow or covered its head with the bed clothes *This diagnosis is nearly always erroneous* A careful autopsy and a blood culture made prior to embalming will frequently disclose an overwhelming infection in the blood stream This infection is usually caused by one of the strains of streptococcus Such infections in a small child are swiftly fatal and can generally be found if a careful search is made Under such circumstances death should never be attributed to smothering unless an autopsy discloses characteristic indications of asphyxia

However smothering is a frequent form of homicide and is a particularly common form of infanticide, the act being accomplished by simply holding the hand over the nose and mouth It is likewise often met with in cases of adult homicide Usually the method employed is to hold a pillow, bed clothes or a similar article tightly over the victim's face There are several cases on record of persons having been smothered to death by a large knotted gag being forced into the victim s mouth and the lips sealed with a wide strip of adhesive tape This forced the knot back against the soft palate thereby obstructing the nasal passages Death by asphyxia resulted

ASPHYXIA BY HANGING

Death by hanging is usually suicidal but is sometimes accidental Furthermore, a person may be killed in some other manner and the body then hanged to make it appear like a suicidal death Except in lynchings and legal executions, it is rare that hanging is employed as a means of homicide

A rather common type of strangulation is encountered among teen age boys and occasionally among older men in which the victim has tied himself up with a rope Apparently some sexual gratification is obtained by the feeling of constriction about the neck and he will sometimes arrange a large mirror where he can observe himself in this position In this situation he may slip or the rope may accidentally become tightened about his neck In his efforts to free himself he strangles death quickly follows Some will even dress themselves in feminine apparel tie a rope to a tree or pipe and thus receive gratification from the feeling of constriction about the neck Unexpectedly they lose consciousness and death results These cases are true accidental deaths and the investigating officer should use extreme care before he classes them as suicides

FIG 92 Suicide by hanging *Notice the deep groove left by the rope* In this case the rope was tied directly in front of the neck (Courtesy of C W Muehlberger)

It is not necessary for the body to be *entirely suspended* for death from hanging to take place Any position in which enough weight will be employed to tighten the noose will cause death There are many cases on record of people hanging themselves from bed posts door knobs and similar objects where their feet and other portions of the body are touching the floor

If a small rope or a similar material has been used for the hanging, a *deep groove* will be made in the neck which will remain permanently after death The smaller the constricting material the deeper will be the groove Generally, the groove will be high up on the neck just under the jaw bone and will cross the front of the neck in a diagonal direction, the knot usually being on *the left side*

Fig 93 Death by strangulation Notice the marks left by finger nails on the side of the neck but do not confuse them with adjacent old operation scar tissue which is also present The victim was also struck a blow with a hammer over the right eye

If the investigating officer examines this groove carefully, he will usually find *small black and blue marks along the edges* They are apt to be more common along the lower edge, but may be seen along both sides These are simply minute areas of bleeding due to rupture of small blood vessels in the skin and are *of importance for one purpose* If they are found, it indicates that the person was *alive* at the time of the hanging, and that the body was not suspended following death from some other cause In the negro race, it is almost impossible to see these marks due

to their being concealed by the color of the skin. If they are not found, it does not necessarily mean that death was not due to hanging, but the investigating officer should be put on his guard and should not form conclusions about the cause of death until a complete autopsy is performed or other evidence is gained

Sometimes persons will use anything at hand with which to hang themselves This is frequently the situation when a person is confined in jail; there he may use articles of clothing, pajamas, bed linen or a belt to bring about his destruction *When such articles are used, there will not be a deep groove cut in the neck and the small areas of hemorrhage will seldom be seen under such circumstances.* While dying from hanging or any other form of asphyxia, a person will often expel urine and feces. If the body has been suspended several hours before it is found, postmortem lividity will be well marked in the arms and legs and the head The mouth may be partly open with the tongue slightly protruding Contrary to general belief the neck is seldom broken except in the case of legal executions

When the investigating officer arrives at the scene of a hanging and the person is obviously dead, he is apt to make the mistake of immediately cutting the body down before he carefully examines the manner in which it has been suspended He should make notes, and if possible, photograph the way in which the rope was tied around the neck and the manner in which the other end has been secured. *The method by which the person has been suspended should be investigated, because it is such observations as these which may differentiate a homicidal hanging from a suicidal or accidental death.*

STRANGULATION BY USE OF THE HANDS OR A LIGATURE

When a person has been throttled to death or has been strangled by means of a rope, wire, necktie or similar object, the mechanism of death is the same as that which takes place in hanging. If the hands have been used, grooves will be made by the fingers which will often remain after death the same as the groove cut by a rope or similar article. In addition, usually there will be abrasions of the skin due to the fingernails cutting into the neck, or there may or may not be small areas of hemor-

rhage along these finger marks as along the groove cut by a rope Furthermore, the pattern of the finger marks will disclose whether the victim was attacked from in front or the rear If from the front, generally ***one hand*** clutches the person's throat If from the rear, generally ***both hands*** are employed with the tips of the fingers coming across the windpipe in front In all such deaths there will usually be damage to the structures of the neck, such as fractures of the bones of the larynx and throat This will be disclosed at autopsy

Fig 94 Strangulation of a new born infant (Courtesy of C W Muehlberger)

ASPHYXIA BY CHEMICALS

There are many chemicals which are extremely irritating to the nose, throat and air passages Some of the common ones are household ammonia, chloroform and sulphur dioxide which is used *in many electric refrigerators* When a *person* breathes these fumes in high concentration, they may be so irritating that a paralysis of respiration and death will result This commonly happens when a cloth is saturated with chloroform and held over a person's nose and mouth The fumes are so intense that he is unable to breathe The victim loses consciousness and dies quickly from asphyxia

Other gases which cause asphyxia by preventing the hemoglobin from combining with oxygen will be discussed under Chapter 12 on poisoning

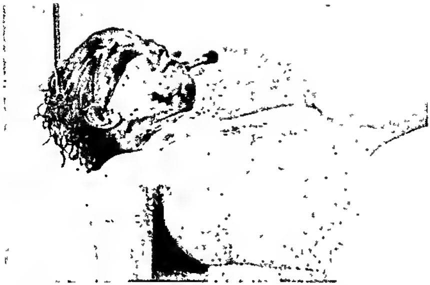


FIG. 95: Death caused by throttling and direct violence. In addition to the strangulation, the victim was struck on the right forehead and suffered a penetrating fracture of the skull.

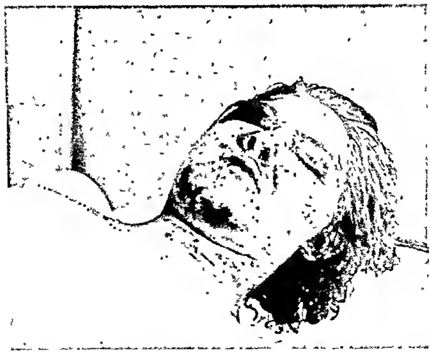


FIG. 96: Another view of the same victim to show in detail the finger nail marks on the neck. The autopsy revealed a fracture of the larynx. (Figures 95 and 96 by courtesy of Dr. Charles Black.)

Fig 97 Characteristic indications of death due to asphyxia A woman was accosted by a drunken man on the street and struck on the larynx (Adam's apple) She rapidly developed difficulty in breathing and was taken to a hospital where she died three hours after the attack This photograph shows the larynx (at the top) and the windpipe cut open so as to show the inside Notice the bleeding and swelling in the larynx (black arrow) which was sufficient to prevent air from entering the lungs The dark spots on the lungs shown by the white arrows are the small hemorrhages which are so characteristic of deaths due to asphyxia (Courtesy of Ralph Turner)

MEDICAL NOTES ON DEATHS DUE TO ASPHYXIA.

Irrespective of the cause of asphyxia there are certain pathological findings which will usually be found at autopsy

1 Edema of the lungs

The lungs will be more or less water logged and in some cases fluid will even be found in the pleural cavity

2 Dilatation of the right side of the heart

3 Petechial hemorrhages of the pleura and pericardium

At autopsy, in addition to the usual examination, there should be removal en masse of the neck structures, including the tongue, larynx, trachea, esophagus, thyroid and cricoid These should be examined carefully for evidence of fracture of the cartilages and hemorrhage It is not necessary to extend the incision up into the neck so high that it cannot be covered by ordinary clothing, but with a long knife it can be removed from below without difficulty In addition, if there are marks on the neck of a rope or fingers, cut blocks of tissue about an inch square through the area of impression and deep enough to include the muscle layers Have these examined microscopically for hemorrhage

Be on guard in the case where there is an indication of a ligature like a rolled up sheet or where pajamas have been used for strangulation or hanging These may leave little or no mark on the neck either externally or internally, and the pathologist is on very thin ice in such cases

Chemical Determination of Asphyxia — A new method for the determination of death due to asphyxia has been described by Dr Alfred F Goggio of Harvard Medical School He has conducted extensive experiments on dogs and has found that in deaths due to asphyxia the oxygen content of arterial blood is very low In all cases it was less than one volume per cent Samples of arterial blood removed from normal dogs after sudden cardiac death (electric shock) were found to contain a high content of oxygen His experiments indicated that this is an accurate method for differentiating death due to asphyxia from other types of sudden death

As previously mentioned, persons may be killed and the body then hanged to make the death appear suicidal and allay suspicion of murder Not long ago I was called on a case where a young woman, twenty years of age and the mother of four children, was found hanging by a clothes line in the stairway of her farm home The rope had been tied around a banister rail on the floor above Although it was believed to be a suicide at the time, some circumstances later caused an investigation to be made and an autopsy was performed about a month after death The autopsy and the subsequent examination of the tissues showed that death was due to asphyxia but that the woman had been

dead before the body was hanged. The circumstances under which the body was found indicated that smothering was the only way that an asphyxial death could have been accomplished, and then the body suspended after death This led to the arrest of her husband, and his brother and mother They confessed that they had entered into a plot to murder her and that was in fact, the way her death had been brought about.

CHAPTER 11

Drowning and Bodies Found Dead in Water

MECHANISM OF DEATH

WHEN A PERSON drowns, he dies from asphyxia, but there are certain characteristics in drowning deaths which merit special consideration. There has been so much misinformation about drowning deaths and methods of reviving those who have suffered submersion that it is necessary to explain what generally happens during the process of drowning

Drowning deaths are usually accidental The individual is suffering from severe fright and is struggling violently. His muscular efforts will force his body out of the water with the result that when it sinks back, it is completely submerged During the course of his struggles, a certain amount of water is drawn into the throat and windpipe and even into the lungs. The water in the throat stimulates choking, and the irritation to the mucous membranes lining the air passages causes the production of a large amount of mucus in his throat and windpipe. Mucus is tenacious, colorless and sticky and when it is mixed with water, the violent breathing efforts cause the production of a sticky, lathery foam. Not infrequently the water in the throat causes the victim to gag and vomit so that vomitus from the stomach may also be mixed up in this sticky foam. This foam which is produced acts as a foreign body in the windpipe and throat and effectively inhibits the passage of air into the lungs In addition, the muscles of the throat, neck and chest go into a violent spasm, breathing is restricted and unconsciousness rapidly follows. Death then results from asphyxia. ***It is not often that a person dies because his lungs are filled with water.*** At autop-

sies water is seldom found in the lungs in more than small quantities Consequently *the old methods of attempting to revive a person by rolling him over a barrel or log are without merit and are seldom successful*

There is also evidence of violent muscular effort in drowning deaths In his frenzy, a person will grasp at anything and frequently the hands after death are found to be grasping mud grass or similar objects Persons who drown while fishing will frequently be found still tightly grasping the fishing rod A careful examination of the palms of the hands may reveal marks where the fingernails have cut into the skin thus indicating clenching of the fists The old adage about a drowning man clutching at a straw contains a large amount of scientific truth

It has been widely believed that a drowning person goes down three times before death finally occurs There is no truth whatever in this myth The person may sink the first time down or he may go under many times depending upon how long the struggle continues before asphyxia renders him unconscious

THE SINKING AND RISING OF DROWNED BODIES

The human body is slightly heavier than fresh water Consequently when unconsciousness takes place the body sinks Fat bodies are slightly more buoyant than are thin bodies but still all bodies will sink in fresh water If there is considerable clothing on the body along with shoes articles in the pockets and other paraphernalia it renders the body considerably less buoyant The question is often asked When a body sinks how far down will it go? There is some dispute on this point but the very best evidence indicates that a body will go to the bottom regardless of how deep the water may be unless it meets with some obstruction or upward current which tends to prevent it As a body sinks into deep water the pressure of the water tends to compress gases in the abdominal and chest cavities with the result that the body displaces less water as it sinks deeper and consequently becomes less and less buoyant the further down it goes

Almost without exception a dead body lying on the bottom of a river or lake will come to the surface again This is due to the gas formed in the body tissues because of decay and putre

faction When enough gas is formed to inflate the tissues and distend the skin, the body then becomes lighter than water and rises to the surface This process is due to the action of bacteria within the body Consequently, ***the length of time which elapses before the body rises to the surface*** depends not only upon the amount of fat contained in the body but even more upon the ***temperature of the water*** If the water is quite warm as it may

FIG 98 A dead body becomes very buoyant after the tissues have become distended with gas The body of this child came to the surface in spite of the concrete block that had been wired to it

be in the middle of the summer, the formation of gas within the body takes place rapidly and the body may rise to the surface in a day or two However, if the water is very deep and cold as for instance, in the Great Lakes during the winter, bacterial action takes place very slowly, and it may be a matter of several weeks before the body appears on the surface When the body becomes greatly distended with gas, the tendency to float becomes very great and it is no easy matter to sink a dead body and make it stay down In my own experience, I know of a case where two bodies reappeared on the surface, although window weights had been wired to the arms and legs in an effort to keep the bodies submerged

FIG 99 *The characteristic foam* which extrudes from the nose in a case of drowning This case was complicated by the fact that the victim had been gagged by means of a large piece of cloth which had been packed into her mouth The body was found in a well

FIG. 100: The gag being removed from the victim's mouth. Despite th fact that the gag alone might have been sufficient to cause death, *the foan* extruding from the nose is good evidence that the victim was still aliv when thrown into the well and that the actual cause of death was drown ing

A question frequently asked is, "When a body drowns where may you expect to find it and if it later comes to the surface where is it apt to appear?" *When a drowning takes place in a river, the most common mistake is to start searching for the body too far downstream* Sinking takes place quite rapidly with the result that the victim reaches the bottom close to the place he was last seen on the surface When the body starts to rise it will appear on the surface not very far from where it disappeared If drownings take place when the river is swollen, as it may be in the spring of the year, the current is very rapid and the supposition is that the body will be carried a long way before it strikes the bottom or encounters some other obstruction The fact that the current on the surface of a river is entirely different from the current on the bottom is seldom considered While the speed of the current on the surface may be eight or ten miles an hour, the speed on the bottom is frequently negligible and the current between the surface and bottom will vary accordingly Consequently, the deeper a body sinks the slower is the motion of the current However, the body soon reaches the bottom where there is practically no current and there it stays It is rare, indeed, that the victim is found downstream more than a few hundred yards at most, from where it disappeared and more often than not the body is recovered surprisingly close to where it was last seen It is true that when the body rises to the surface after several days it may then drift a considerable distance from the site of death, and in large lakes it may be found miles away

Exception —Occasionally it is true that a body will drown in fresh water and yet not sink This may be due to an excessive amount of gas in the intestinal tract or to a spasm of the throat occurring at the moment that the lungs were deeply distended with air Likewise there may be air trapped in water proof clothing which is sufficient to maintain buoyancy

APPEARANCE OF A DROWNED BODY

If death has been due to drowning, the body possesses certain characteristics which should be looked for to differentiate it from a body found dead in water from other causes

The characteristic most indicative of drowning is the appear

FIG 101 *Mutilation by water animals* This boy was murdered by stabbing and the body thrown into a swale hole that connected with a small stream Five days later the hole was drained and the body found Note the tissues missing from the nose and chin When the body was recovered a large snapping turtle was also found The turtle was autopsied and in its digestive tract were tissues which could positively be identified as having come from the face The mutilation around the ear was done by the murderer with a knife (Crabs are notorious for feeding on dead human remains)

ance of the *white foam* extruding from the nose and mouth This is the foam formed in the windpipe and other air passages during the act of drowning Gases generated within the body keep forcing this foam out, and it can be wiped away from the nose and mouth only to reappear in a few moments While it is true that death due to other causes, such as certain types of heart disease, may cause a foam to appear at the nose and mouth, the foam is more apt to be pinkish or tinted with blood and seldom has the white appearance of the foam coming from drowned bodies

Another common indication of death due to drowning is the presence of mud, grass and other objects grasped in the hands If such is found together with nail marks in the palms of the hands it is a good indication of a drowning death

The amount of swelling and bloating depends largely on the temperature of the water and how long the body has been immersed ***There is no fixed rule to determine accurately how long a body has been in the water,*** beyond the fact that it may vary from a day or two to several weeks depending upon the above conditions Some experiments have been conducted to try to determine how rapidly decomposition will take place in certain instances For instance, one observer reports that in water of seventy degrees Fahrenheit, the outer layer of skin of a baby will be loosened and largely gone after twenty four hours

Portions of the body, especially about the face, may be eaten by turtles crabs and other marine life The appearance of such a body may raise the suspicion that there was mutilation prior to the body being placed in the water, but the possibility of this mutilation being due to turtles and fish should not be overlooked Some time ago a ten year old boy was murdered in Michigan and the body thrown into a swale hole connected with a small stream When the body was found about a week later, the lips, nose and ears were entirely gone The hole was drained, and a large snapping turtle was found The turtle was killed and autopsied and in its digestive tract were found tissues which the pathologist could positively identify as having come from the boy's face

As putrefaction continues, the gas escapes from the tissues bloating disappears and the body may sink again to stay down permanently

FIG 102 Body found in a cistern where it had been for several weeks The victim had been killed by blows on the head Pinned to his undershirt was found about $2000 in bills A gang murder

Was Death Due to Drowning or Was the Body Dead When Placed in the Water?—Apart from its importance in criminal cases, *this question often arises in civil suits* when insurance claims are involved In civil matters, there is a presumption at law that a body found dead in water came to its death by drowning Consequently, the burden of proof is on the party claiming a different cause of death The reason for this legal presumption is that there are many things which may cause a person to become temporarily unconscious, such as epilepsy, fainting, heart disease, sun stroke, etc Ordinarily a person will revive after a few minutes but, if he happens to be standing in water, sitting in a small boat or in bathing, he becomes submerged and dies, however, the cause of his death is drowning *and not the medical condition causing his unconsciousness*

A few years ago a man went trout fishing with two companions They were wading the stream and fishing in isolated points When this man failed to appear at their camp for lunch, his friends started a search and found his body in a deep hole

in the river, the creel floating on the surface and his fly rod still clenched in his right hand The body was dragged to the bank and some time later was viewed by the coroner who filled out the death certificate in this manner —"Body found in Pere Marquette River No water on lungs" No autopsy was performed

It happened that this man carried a sizeable insurance policy which paid double indemnity for accidental death The insurance company paid the face amount of the policy but refused to pay the double indemnity claiming that there was no evidence of drowning and, further, that the statement "no water on lungs tended to prove definitely that drowning was not the cause of the death Due to the presumption at law, the burden of proof was on the insurance company to prove *what* was the cause of death They were unable to do this Furthermore the statements offered by witnesses concerning foam extruding from the mouth the fishing rod clenched in his hand and other facts made strong evidence to support the presumption of drowning The court rendered a verdict in the widow s favor In all such cases, an autopsy should be done, because the cause of death may come into dispute later on

Unusual Suicidal Drownings —Occasionally a body is recovered from the water with the legs bound together weights attached and other evidences of an attempt to keep the body submerged The investigator should be on guard not to immediately conclude that the victim has been murdered There are many cases on record of suicides having gone to great lengths to insure the permanent submersion of their bodies A careful examination should be made for head injuries bullet wounds evidences of strangulation and other indications of homicide before a conclusion of death due to murder is reached

MEDICAL NOTES ON THE AUTOPSY

If a body has been in the water for a considerable time the identification may become very difficult The features are grossly distorted by bloating so that resort must be made to other methods of identification A careful examination of scars tattooing and dental repair is necessary It sometimes happens that the skin of the fingers may still be so well preserved as to give satisfactory prints except that it is excessively shriveled

In those cases, the skin from the fingertips should be dissected with a sharp knife, and then when these are placed *over the finger of the fingerprint expert, he may be able to get a very satisfactory* impression. There should be a careful examination of the body for evidence of violence, such as a fractured skull, knife wounds, etc. If there is reason to suspect that death was due to gunshot wounds, it may be necessary to x-ray the body in an endeavor to locate bullets, if present.

A remarkable occurrence near Sydney, Australia, illustrates the importance of these observations A fisherman returned to port and announced that his partner had fallen overboard and drowned. A few days later a large shark was caught some distance off shore and towed in where it was cut up. In the shark's stomach were found portions of human body and it was possible to identify them as belonging to the body of the supposedly drowned fisherman. This was accomplished by means of numerous tattoo marks and other scars which made identification possible. Furthermore, a careful examination showed that portions of the body had been cut off with a sharp knife, and they had been swallowed whole by the fish. It became apparent that the man had been murdered, the body dismembered, and then tossed overboard. The murderer was convicted and executed

Indications of Drowning from the External Appearance of the Body.—

1. *White foam* extruding from the nose and mouth.

2. Objects clutched in the hands—grass, mud, and other objects.

3. Fingernail marks in the palms of the hands.

4. Pale appearance of the body. This is particularly noticeable if the drowning has been in cold water, because the contraction of the blood vessels in the skin has forced the blood into the central portions of the body. The presence of "goose flesh" used to be considered an important sign of a drowning death, but actually has no such significance

5. Postmortem lividity is apt to be most marked in the head and neck, due to the fact that the body is apt to settle with them in a dependent position.

6. The mouth is usually open.

Internal Examination of the Organs.—

1. Upon opening the chest cavity, the lungs are found to be distended, soggy and with a fine foam in the trachea and bronchi.

2 There is dilatation of the right side of the heart The heart is flabby, and the right side is dilated and filled with dark red blood The blood is unclotted and is usually hemolyzed due to the absorption of the drowning fluid into the system.

3 *Water in the stomach and duodenum*

4 The presence of algae and other marine particles in the stomach and adhering to the sides of the air passages

FIG 103 *A drowning man clutches at a straw* About two weeks after disappearance, the body of this man was recovered from a small bay on Lake Michigan The body was so decomposed that it was impossible to determine the cause of death from an examination of the internal organs However his left hand still clutched twigs and grass proving beyond doubt that death was due to drowning

Fig 105 *Body of a murdered woman after several days in the water Note* the separation of the hair and the distention of the tissues with gas The incisions in the breasts have been made by the patholog st to release the gas The white powder is lime that has been sprinkled on to diminish the odor *It is not of much help* (Courtesy of G Russell Carrier)

CHEMICAL EXAMINATION OF THE BLOOD *FOR EVIDENCE OF DROWNING*

Dr Alexander O Gettler, toxicologist of the Department of Medical Examiners, New York City, first demonstrated in this country a test for determination of drowning by means of chemical examination of the blood When fresh water is taken into the air passages and lungs, it is rapidly taken up by the blood stream and carried back to the left side of the heart The test consists of withdrawing specimens of blood from both the left and right ventricles and comparing the chloride content of the two specimens If the chloride content on the left side is materially reduced in comparison to that in the specimen taken from the right ventricle, it is evidence of dilution due to the aspiration of water and that death was due to drowning

If a body drowns in sea water with its high salt content, *the*

chloride content of the blood taken from the left ventricle will be considerably increased, over that removed from the right side of the heart

Dr Walter W Jetter, instructor in legal medicine at Harvard Medical School, has done extensive research on this subject He states

> "If, prior to the onset of putrefaction, there is a significant reduction (25 per cent or more below the expected normal) in chlorides in both sides of the heart, or if the reduction in the left side is by 50 per cent or more of the expected normal, death has probably resulted from drowning in fresh water Even though putrefaction is present, if the blood chlorides on the left side of the heart are found to be 25 per cent or more lower than those on the right side, death by drowning in fresh water is to be suspected
>
> "If the chlorides in both sides of the heart are increased by 25 per cent or more above the expected normal levels in an individual who had apparently been in good health prior to death, or if the chloride content in the left heart is 25 per cent or more higher than that of the blood in the right heart, death by drowning in sea water is probable If putrefaction has occurred the absence of such changes does not exclude the possibility of drowning in sea water"

Dr Jetter's experiments in this field have led him to conclude that when death by drowning in sea water is suspected, a comparison of magnesium content of the blood taken from the right and left ventricles is a more reliable procedure than the chloride determination

Changes of Blood Volume in Drowning Deaths—Scientists at the University of Texas Medical Branch have demonstrated that there is a sudden and pronounced dilution of the blood in fresh-water drowning which is demonstrated by a rapid fall in the levels of plasma, protein, hemoglobin, chloride and other constituents of the blood The blood volume may be diluted to as much as twice its original amount These sudden alterations in the concentration of the blood undoubtedly have significant effects on heart action Conversely a strong concentration of the blood with reduction in volume occurs in sea water drowning

Nearly one third of the liquid elements of the blood may be removed with startling rapidity The Texas experiments showed that the heart may retain good function for nearly twice as long in sea water drowning as in fresh water drowning Consequently, it is apparent that chances for successful resuscitation are much better if the submersion has occurred in salt water rather than in fresh water

CHAPTER 12

Examination of Burned Bodies

ONE WOULD think that the human body would be very resistant to destruction by fire, but this is not actually the case. Underneath the skin is a layer of fat which may be quite thick in heavy individuals. This burns readily and the destruction of tissue after a comparatively small fire may be great. Strangely enough, even bone is readily destroyed by fire. It is not uncommon to find a body with a leg or an arm burned off completely even though the building from which it was recovered may not have been destroyed. The abdominal wall burns readily and allows the contents of the abdomen to spill out. In many cases it seems that the destruction of tissue by burning is out of all proportion to the intensity of the fire which caused it.

While many of the deaths due to burning are baffling to the investigating officer, ***in few other fields of legal medicine does science have so much to offer as in the examination of burned bodies.*** Frequently the destruction of tissues is so great that it is thought that nothing further can be learned by an autopsy. This is seldom true; no matter how badly a body is burned, a careful and complete autopsy should be done. Often much can be learned.

Complete Destruction of the Body.—The question is often asked if it is possible for a body to be consumed in a furnace to such an extent that it is impossible to recognize any remaining fragments as of human origin. The answer is that under certain conditions it is possible for this to be accomplished. In a furnace which has a forced draft there will be numerous areas in the firebox where the temperature may be well in excess of 2000 degrees Fahrenheit. If the remains of the body are pushed around with a poker so that the full advantage of the extremely hot areas can be utilized the bones may be reduced to such small

particles that they will go through the grates Even if small fragments of bone are recovered, it is generally impossible to identify their origin

When such an event takes place tenants of the building are apt to notice the excessive heat and likewise there is a very offensive odor coming from the chimney which may attract attention in the surrounding area

IDENTIFICATION

Following a careful examination of the scene of a fire where the remains of a body are found, questions usually present themselves in this order

1 Are the Remains of Human or of Animal Origin?

This question would appear ludicrous were it not for the fact that a mistake is sometimes made A Michigan farm house burned causing the death of an elderly man a boy and a dog The investigator appeared the following day and recovered the remains of the old man from the ashes The remains of another body were found and he identified them as that of a dog and tossed them back among the ruins He later found what he identified as the body of the boy This was taken to a funeral home and placed in a coffin Shortly before the time of the funeral, another officer surveyed the scene and carefully examined the body that was thrown back into the ashes He became convinced that this was the body of the boy He removed it and took it to a pathologist who corroborated his opinion It then developed that the body placed in the coffin was that of the dog Fortunately the mistake was rectified in time for the funeral

Generally there is enough left of the bones of the head and the teeth to identity the body as that of a human being rather than that of an animal If there is any question whatever about the remains being human, a competent pathologist can readily distinguish bones of human origin from the bones of other animals

2 Was the Victim Male or Female?

When a body is completely destroyed by burning the organs which usually are last to be consumed are the uterus in the fe

Fig 105 Torch murder Four young people, who were sitting in this parked car, were assaulted and killed by three men The car was then set afire Note the charred remains of one of the bodies on the floor of the car

male and the prostate in the male In the burning of an ordinary frame dwelling, it is seldom that the body of an adult will be so extensively destroyed that the pathologist cannot readily determine the sex Even if the soft tissues are entirely gone, the bones of the pelvis and the thigh have certain characteristics of formation which make it possible to determine the sex of the body

3. What Was the Height and Approximate Age of the Deceased?

In most cases a sufficient amount of the body is completely destroyed to prevent an accurate measurement of the height of the individual. In such cases a fair approximation of the person's height can be obtained by the measurement of such bones as the thigh bone or the bones of the arm

FIG 106 The remains of one of the bodies removed from the car shown in *Figure 105 This illustrates the enormous tissue destruction in even small fires*

A pathologist will have tables which will give the relationship of the length of certain bones to the total height. It is impossible to make even a fair approximation of a person's weight from the study of the bones alone

Likewise it is possible to get an approximation of the age of the deceased from an examination of the teeth and bones The doctor will have tables which give the ages at which the various teeth erupt and the sequence in which they appear In an individual up to about twenty-five years of age, a fairly accurate approximation of the age can be reached by a study of the num-

ber and condition of the teeth Through adult life and old age the condition of the teeth will frequently disclose valuable information as to the person's age but the approximation is not nearly as accurate as in a younger individual The services of a dentist in matters of this kind are often valuable

In cases of children and young adults, much can be learned about the age of the deceased by an x ray examination of certain bones At birth the skeleton is in only an initial stage of development Gradually during childhood and young adult life, the bones increase in size and calcium and other mineral salts are deposited in them By taking an x ray of certain bones such as the hand, shoulder and pelvis, it is possible to get an accurate idea as to how far development has progressed and consequently the age of the deceased After adult life has been reached and the skeleton is completely formed, it is difficult to derive much information of value from x rays However, they may be of value in disclosing old fractures, foreign bodies or other abnormalities which will assist in the identification

4 **Who Was the Deceased?**

In examining an unidentified body, care should be used not to overlook healed fractures or old scars which might aid in identification In addition, such articles as jewelry and dental repair should be carefully examined One of the principle difficulties in identification arises when several people have been burned in a big fire When the Hotel Kerns burned in Lansing, Michigan a few years ago, thirty four people lost their lives and many of the persons were burned to the point where only a few bones remained A great deal of careful work was done on these bodies, but in spite of every known scientific aid, it was impossible to make a positive identification in seven cases

For additional details on identification problems see Chapter 5 on *Identification of Dead Bodies*

WAS THE DECEASED ALIVE OR DEAD AT THE TIME THE FIRE STARTED?

It is rarely that a body will be so badly burned that it is not possible to determine this matter of extreme importance, i e, was the deceased alive or dead at the time the fire started?

FIG 107 A tenement house fire in which seven persons were killed Note that the floor and ceiling were not burned through (Courtesy of John F O Connell New York)

There are two methods by which an expert can solve this question If the deceased was alive and breathing at the time the fire started, ***smoke will have been inhaled Small carbon granules*** will be found deposited in the bronchial passages and other air spaces of the lungs If there is any lung tissue that has not been consumed *the pathologist will be able* to make this determination

An even more accurate procedure is to determine the amount *of carbon monoxide present in the blood or other tissues* ***Carbon monoxide*** is produced in large quantities whenever fire is present This gas has a very strong affinity for the red blood cells If the person drew in a few breaths after the fire started carbon monoxide would be absorbed by the blood and the amount definitely increased above normal Strangely enough a body can be burned to the point where the arms and legs the top of the

FIG 108 One of the bodies recovered after the fire shown in Figure 107 Note the bone destruction on the skull left arm, and left leg (Courtesy of John F O Connell, New York)

head, most of the contents of the abdomen and chest are destroyed, yet it is still possible to get a good specimen of blood to make this analysis *This is a matter of extreme importance No effort should be spared to determine this point*

In situations where a violent explosion has been the cause of the fire the victim may show little or no evidence of an increase of carbon monoxide in the blood even though the body has been badly burned This is due to the fact that the blast produced immediate death or at least caused the victim to cease breathing Consequently there was no opportunity for the blood cells to take up carbon monoxide The autopsy surgeon should pay particular attention to the heart to search for bleeding under the inner lining of the left chamber If found, it is good additional evidence that the deceased was alive at the onset of the fire and that death resulted from it

Did an Assault Precede the Burning?

One of the elements that makes a torch murder so baffling is that the skin may be more or less destroyed, concealing marks

of violence which the deceased may have suffered before the burning However, it is possible to tell with a high degree of accuracy whether an assault took place

If certain portions of the body have been subjected to intense heat but with little or no actual contact with flame the skin may be split in such a way that it appears to have been caused by a knife wound However the edges and deeper portions will show no evidence of bleeding indicating that death has already taken place

If the deceased had suffered a previous blow on the head of any great violence this fact can be determined from an examination of the skull and the brain even though the scalp may be entirely destroyed The skull cap should be carefully removed and examined both inside and out for evidence of fracture If a violent blow had been struck on the head small areas of congestion and bleeding may be found on the surface of the brain underneath the point where the blow was inflicted

Exception —Not all fractured skulls found after severe fires are a result of direct violence The extreme heat alone will cause fractures in some instances Often a high degree of care is required to determine whether the fire or a blow produced the fracture

In general a fracture caused by heat alone is quite apt to be a fairly straight line and may be several inches long whereas a fracture caused by a blow on the head is more likely to show several different cracks radiating out from the point of injury The inner table of the skull is frequently broken inwards indicating a direct blow on the outer surface of the skull

Care must be taken not to misinterpret bleeding underneath a skull as evidence of direct violence to the head before the fire Occasionally there will be a considerable amount of blood between the under surface of the skull and the heavy membrane which covers the brain Generally it *is* present on both sides of the head and may be caused by heat alone When blood is found in the location due to heat alone the brain underlying this area does not show evidence of violence as it generally does when a blow on the head before death has been the cause of the bleeding

After the chest and abdominal cavities have been opened a careful examination should be made from the inside to see if

there is evidence of knife or bullet wounds The outside of the body may be so badly burned that such wounds, if present, will be overlooked, but they can be readily seen from the inside.

If there is reason to suspect that the deceased might have been shot before the body was burned, a careful attempt should be made to locate embedded bullets or other materials The use of the x-ray may be of great importance in determining this factor. This procedure has led to the solution of several murders

Fig 109 Another of the recovered bodies A great deal can be learned from an autopsy on bodies burned as badly as these Where there is any suspicion whatever of foul play, ***have a complete autopsy performed,*** even if the body is burned much worse than these (Courtesy of John F O'Connell, New York)

Significance of Blisters.—If a body has not been actually consumed by fire there may be one or more blisters on the skin which may range in area from the size of a dime to several inches in diameter. Dutra has pointed out that a careful examination of these blisters may disclose whether they were made before or after death took place.

If the victim was alive at the time the blister was formed there will be a narrow zone of redness around the margin and when the blister is opened it will be found to be completely filled with a light straw-colored serum. This serum is thrown out by the cells in the under-layer of the skin. It cannot be produced unless life is still present and the blood is circulating.

Another type of blister found on bodies which have been exposed to fire greatly resembles the type of blister just described except that the red zone around the margin is ill defined or entirely absent. When opened, this blister is found to contain only air with very little moisture in evidence. This type of blister is caused by steam being produced within the layers of the skin and is an excellent indication that death had taken place before it was formed.

Examination of Lung Tissues for Fat Globules.—The purpose of this analysis is to determine whether or not the deceased suffered direct violence to the soft tissues of his body while still alive. Everyone has a certain amount of fat deposited underneath the skin, in the abdominal cavity, and in the bone marrow. If he is struck a violent blow, some of this fat will be dislodged and it will be taken up by the blood stream and carried back to the heart. From there it goes to the lungs, but here the blood passes through blood vessels so small that these fat globules are strained out. When the pathologist examines the lung tissue under his microscope these fat globules can readily be identified by means of a special stain. The skin and underlying fat where the deceased suffered the blow may have been entirely destroyed by the subsequent fire, but if the fat globules are found in the lungs, it means two things:

1. *That the deceased suffered direct violence to some portion of his body.*
2. *He was alive when the wound was inflicted.*

It is important at the autopsy to obtain adequate specimens of the blood and of other organs and have them examined for alcohol, chloroform or other poisons. This will determine whether or not the deceased was intoxicated at the time of his death and also whether any poison had been administered which might indicate murder. It is always necessary that all the other points mentioned in Chapter 1 on the medicolegal autopsy should be carefully observed, such as the examination of the stomach contents, to find out how long after the last meal death took place. If these procedures are carried out, an amazing amount of information can sometimes be obtained.

One midnight during severe winter weather a young farmer called his father in a nearby town to say that his house was on

fire and to send help When neighbors arnved twent) or thirty minutes later, they found him rolling in the snow in front of the house, apparently heside himself with grief, and indicating that his wife was still inside No flames were visihle from the outside, but a neighhor who went up on the porch could see a fire burning in the living room On entering the bouse he found a large overstuffed chair which was hlazing to the ceiling Lying on the floor in front of the chair was the young farmer's wife Her clothing was entirely burned off except for the shoes, and an area of the rug about the body was hurned He dragged the remains out into the open on the porch and put out the fire with three or four buckets of water which he carried from the watering trough

The husband said that he had gone to the barn about 11 00 P M to care for some calves and that while out there, he heard an explosion in the house and the fire followed The death was passed off as accidental and the hody buried Several events fol lowed to create suspicion among the neighbors, and finally, a month later, the body was disinterred and a careful and com plete autopsy done The results of the autopsy showed that al though the scalp was completely destroyed, there was an area of hemorrhage in the brain indicating that a severe blow had been struck while she was still alive An examination of the lungs showed large numhers of fat globules but an absence of smoke particles This was evidence that she had suffered severe violence while *still alive, but had not breathed after the fire* started The fact that she was dead before the fire started was further corrohorated hy the finding of a normal amount of car hon monoxide in her hlood Further examination of the tissues showed the presence of considerable quantities of chloroform, as *well as alcohol After these findings* were presented *in* court, a recess was declared during which the defendant husband pleaded guilty The murder had taken place in exactly the method indi cated by the prosecution

During the evening preceding the murder the couple had entertained some neighhors and a lunch consisting of sand wiches and home canned grape juice had heen prepared The husband had heen spiking his wife's grape juice all evening, hop ing to get her intoxicated enough so that she would be unable to resist the assault which he had planned After the neighbors left,

he assaulted her with a doughnut iron and struck her several times over the head and body. After she was overcome, she was placed in the large Morris chair where he held a cloth saturated with chloroform over her nose and mouth. The actual cause of death as determined by the autopsy was asphyxia due to the concentrated fumes of the chloroform After she was dead, the husband called his father to say that the house was on fire and later he poured fuel oil over the body and chair and started the blaze. The heat of the fire caused a contraction of the muscles of the body pitching the corpse forward onto the floor where it continued to burn. In spite of the elaborate planning and preparations made to commit this murder, the amazing fact is that the house itself never actually caught fire, but even had this been the case, a careful autopsy would undoubtedly have disclosed the crime.

CHAPTER 13

Deaths Due to Poisoning

GENERAL CONSIDERATIONS

A POISON MIGHT be defined as an agent which, when introduced into animal or man, produces a morbid or deadly effect This definition, however, has to be qualified because almost any substance such as common table salt, or even water, might kill a person or produce a serious illness if taken in sufficient quantity

In its truer meaning, therefore, a poison is a substance which, when introduced into the body in small quantities, such as a teaspoonful or less, causes a harmful or deadly effect

Poisoning is one of the most ancient forms of murder In medieval times it was so common that royalty customarily had official tasters to sample the food before it was served to members of the household

In no other branch of medicolegal investigation, is it so important to have an accurate history of the events preceding death as in cases due to poisoning The manner of death and the type of illness preceding it frequently give salient clues to whether or not death was due to poisoning, and if so, what type of poisoning caused it

The question of poisoning will often arise in the investigation of homicides that apparently are due to other causes This possibility must always be borne in mind by the investigator because occasionally amazing facts are disclosed Suicide or murder may be attempted by means of poison, and failing in this, some other means may be used to accomplish their destruction

Poisons are classified into six main groups according to their chemical characteristics Each poison has some characteristics which are common to all the members of its group A knowledge of these group distinctions will greatly facilitate the investigation of any poisoning case

A Simple Classification of Poisons follows

A Gases

B Anesthetics

C Corrosives

1 Strong Mineral Acids

2 Strong Alkalis

D. Metallic Poisons

E Organic Poisons

1 Alkaloids

2 Non-alkaloids

F Food Poisons

GASES

There are many gases which are very poisonous however the great bulk of medicolegal cases are caused by only two or three of these gases By far the most important one is carbon monoxide This gas causes more deaths than all other poisons combined In fact, only a few years ago in New York City it even caused more deaths than traffic accidents

Carbon Monoxide (CO) —Carbon monoxide is produced wherever there is combustion If combustion is incomplete, the amount of the gas is greatly increased A faulty gas fixture burning with the flame yellow instead of blue will produce large quantities of carbon monoxide Likewise, all internal combustion engines produce large quantities of this gas Explosions of dynamite and similar substances also produce carbon monoxide in large quantities In addition it is found in abundance in artificial illuminating gas The gas is colorless, odorless and has about the same weight as air with which it mixes freely Consequently, it is distributed by ordinary convection currents and will penetrate a house or other building where it may cause serious injury

The action of carbon monoxide upon the body is very interesting In Chapter 10 on asphyxia there is a description of how the red blood cells carry oxygen in the blood stream to the tissues of the body There the cells give up the oxygen and then combine with carbon dioxide which is carried back to the lungs and exhaled

Carbon monoxide has a tremendous affinity for the red blood cells This attraction is nearly three hundred times that of oxygen for the red blood cells Consequently, when carbon monoxide is present in the atmosphere, even in small quantities a certain proportion of the red blood cells become tied up by the carbon monoxide and consequently are unable to transport oxygen to the tissues As long as these red blood cells are combined with carbon monoxide, they are useless to the body A person who

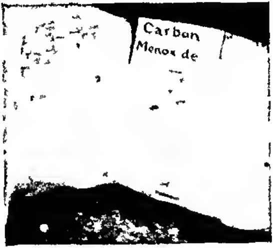


FIG 110 Carbon Monoxide Poisoning Note the pinkish discoloration of the skin The discoloration is generally not spread over the entire body but is patchy as is shown in the picture If postmortem lividity has become established, it will be noted that it is much redder than is the case generally (Courtesy of C W Muehlberger)

has 30 per cent of his blood cells saturated with carbon monoxide is in many respects in the same situation as one who has lost 30 per cent of his blood It can be seen then that the condition which really kills a person who has been poisoned by carbon monoxide is the lack of oxygen in the brain and other tissues

The percentage of blood cells which must be saturated by carbon monoxide before death occurs varies widely depending on many circumstances Generally when there is about a 50 per cent saturation of carbon monoxide, death takes place However if a person happens to be asleep or under the influence of a

narcotic at the time, it may require considerably more saturation, because the oxygen demand by the body tissues is comparatively low under such conditions In such cases, death may not occur until there is about an 80 per cent saturation If the same person were doing active muscular work instead of sleeping death might take place with a saturation as low as 40 per cent or less

When poisoning takes place gradually, there is usually a feeling of tightness and constriction in the head followed by severe headache and dizziness Breathing becomes deeper and faster, and vision may be affected There is a state of confusion of the mind and muscular weakness Finally, complete unconsciousness ensues and if the person is still exposed to the carbon monoxide, death will follow If a person is exposed to a high concentration of carbon monoxide he may go through these stages rapidly and become unconscious in a very short period of time It is not uncommon that a person will go through these states without appreciating that there is anything wrong or that he is in serious danger He may become unconscious and die without making an attempt to escape his peril

It is generally true that small persons are more rapidly affected than large persons and small children are particularly subject to the hazard of carbon monoxide It has been a common practice for years for mine workers to carry canaries or mice with them into the mines to test the air These small animals are very susceptible to poisonous gases and if they become unconscious, the miners are warned of their danger

Appearance After Death —When carbon monoxide combines with the hemoglobin of the red blood cell the blood becomes a cherry red After death from carbon monoxide poisoning, instead of having a characteristic ashy gray look the body will have a pinkish healthy looking appearance After postmortem lividity has set in the areas effected will be reddish rather than the blue or purplish color usually observed There may be some pinkish foam extruding from the nose and mouth *It has been said that persons who have died from carbon monoxide do not develop rigor mortis, but this is not true* Rigor mortis develops along the same pattern that follows other deaths

If there is a suspicion that death has been due to carbon

Fig 111 Suicide by carbon monoxide out of doors The victim simply lay under the exhaust p pe of the motor car

monoxide a complete autopsy should be performed A specimen of blood sbould be obtained and analyzed for this gas The body tissues as well as tbe blood will have a distinctively red appear ance In fatal carbon monoxide poisoning the blood ordinarily fails to clot even after days If for aoy reason it is impossible to have a complete autopsy performed a specimen of blood can be collected for analysis at the time of embalming If it shows a carbon monoxide saturation as higb as 60 per cent one may be certain that carbon monoxide was the cause of death If it is fouod ooly io small quantities bowever, such as from one to fifteeo per cent, death cannot be attributed to it

Tobacco smoking appreciably increases the carbon monoxide in the blood and cannot be ignored in tbe interpretation of the laboratory results

Taxicab drivers and others wbo work under conditions where

there is a considerable amount of carbon monoxide in the air, may have a saturation as high as 19 per cent

Carbon Dioxide (CO_2)—This gas has a wide general use in soft drinks, fire extinguishers and is one of the products of combustion and metabolism Carbon dioxide is considerably heavier than air and has little effect except in very high concentrations Consequently, it is encountered in deep pits where there is decaying organic matter and is sometimes found in dangerous concentrations in silos Exposure to high concentration of the gas causes rapid loss of strength so that a person is unable to extricate himself even though he realizes his danger Respirations are deep and rapid and death may follow quickly

Murders have been attempted by placing a large quantity of "dry ice" (carbon dioxide compressed into solid form) near the head of a sleeping person Under certain conditions death could easily be produced in this manner

Ammonia (NH_3)—Poisoning by exposure to this gas is usually accidental and may be caused by the sudden release of large quantities of the gas from a refrigeration system The lesions produced are limited largely to the upper respiratory tract where it causes intense irritation of the larynx, windpipe and bronchi Death may follow after a few hours or two or three days, and an autopsy will reveal that the membrane lining these structures is coagulated and can be removed as a cast The lungs are likewise affected In many ways the action of ammonia in high concentrations is quite similar to that of phosgene, one of the poison gases used in the first world war

Sulphur Dioxide (SO_2).—Poisoning from this gas is almost always accidental and there are no recorded cases of its use in connection with a homicide This gas has been widely used as a refrigerant, many of the older model electric refrigerators still employ this gas Its harmful effect is due principally to its extremely irritating action on the air passages When sulphur dioxide comes in contact with moisture it will form sulphurous acid Consequently, a person exposed to heavy concentrations of this gas will start coughing violently After a few minutes, the coughing may be so severe that he will raise blood In a few cases on record the poisoning has been so intense as to cause death shortly afterwards The strong, pungent odor serves to give

warning of its presence, and ***one should be extremely careful about exposing himself to the concentrated fumes***

FUMIGATING GASES

Hydrocyanic Acid Gas (HCN) —This gas is the most commonly employed agent ***for fumigating purposes*** at the present time It is ***extremely poisonous*** and accidental deaths are common The same form of poisoning is produced when a person takes ***potassium cyanide (KCN) or sodium cyanide*** internally, this is not an uncommon form of suicide and murder When potassium or sodium cyanide is taken internally, it is readily absorbed from the stomach and small intestine, causing death very rapidly If the stomach happens to be filled with food the poison may be greatly diluted, thus reducing the rate of absorption and causing death much more slowly

The cyanides are used quite extensively in industry In addition to their use in fumigation, they are employed in electroplating, heat treating gilding and photography Some forms of silver polish contain considerable quantities of these substances

Following fumigation with hydrocyanic acid gas, it is necessary for the building to be thoroughly aired for several hours before anyone enters The onset of poisoning is so rapid that a person may become unconscious and die before he realizes his danger Sometimes the gas will invade pillows, penetrate bedding and blankets which are stored in a closet to such an extent that they are dangerous unless they are thoroughly aired outdoors I recall an instance in which a family came home after the house was fumigated and supposedly completely aired The mother put a small child to bed covering it with a blanket taken from a closet In the morning the child was found dead Autopsy proved the death to be due to hydrocyanic acid gas

Cyanide, whether taken internally or inhaled in the form of a gas kills a person by interfering with the body's utilization of oxygen carried by the blood Consequently, death is a form of asphyxia In addition, when alkali cyanides are taken internally, there are evidences of corrosion of the lips tongue throat and stomach In cases of acute poisoning the symptoms which develop very rapidly are chiefly dizziness palpitation intense

air hunger, cyanosis (a very dark blue color of the skin) and unconsciousness Violent convulsions may develop, the hands are usually clenched Death nearly always takes place very rapidly As explained before, if there happens to have been considerable food in the stomach at the time the cyanide was taken, these symptoms may be considerably delayed It may be recalled that the murder of Rasputin, the Russian monk, was first attempted by feeding him cyanide concealed in cakes Although he ate several of the cakes, he apparently experienced no great immediate effect, the murder was eventually accomplished by hitting him over the head with a club

Several of the western states now use poisoning by hydrocyanic acid gas for legal execution The condemned is strapped in a chair and the gas generated by means of dropping several cyanide ' eggs into a pan of strong acid thus producing large quantities of the poison gas immediately Unconsciousness takes place very rapidly although it requires from 9 to 20 minutes before the heart stops beating and all signs of life are extinct

The cyanides have a distinctive odor which is quite similar to that of the inside of a peach stone After deaths due to poisoning this odor persists and at autopsy is generally quite noticeable As will be mentioned later under the effects of embalming it should be borne in mind that embalming practically destroys all evidence of cyanide and it is important to remember that if it is to be recovered the autopsy must be performed *before* embalming

Postmortem Appearance —Exteriorly, the most characteristic features are the open staring eyes with dilated pupils frothing from the mouth and bright red or purple patches on various parts of the body Interiorly, the blood is usually coagulated, and in the veins the blood is much redder than normal Small hemorrhages are found in various portions of the body such as the pleura and pericardium If poisoning has been induced by swallowing sodium or potassium cyanide, dark patches due to the corrosive action will be found in the lining of the stomach The characteristic peach pit odor will be present for a considerable time, particularly in the body cavities If a sufficient period of time has elapsed so that putrefaction is well marked, this odor may not be present The presence of cyanide in the blood and tissues may be detected by chemical analysis made as quickly as possible after death

Sulphur.—In the past the burning of sulphur either in its natural state or in the form of candles was very common. The gas produced is sulphur dioxide (SO_2) which has been described previously.

GASES FORMED BY COMBUSTION OF NITROUS PRODUCTS

Nitric Oxide (*NO*) *and Nitrogen Dioxide* (*NO_2 and N_2O_4*).—These gases are generated during the manufacture of such explosives as gun cotton, nitroglycerine and nitro explosives They are also produced in large quantities in the burning of photographic and x-ray film made from cellulose nitrates In high concentration, these gases are very dangerous and may cause immediate death In some cases, the symptoms may be delayed for several hours, particularly if the concentration of the gas is not high. If a considerable quantity of the gases have been inhaled, there is sudden collapse marked by coughing, air hunger, and blueness of the skin. At autopsy, marked congestion and reddening of the air passages will be found, the lungs are congested and water-logged. The blood is extremely dark and has a distinctly acid reaction

A few years ago a famous hospital suffered a disastrous fire in which the fumes from burning x-ray films killed many persons who inhaled them. Since that time, it has been the common practice of hospitals and other similar institutions to store their old films in fire proof vaults outside of the building.

MOB VIOLENCE GASES

Tear Gas.—Chloracetophenone is a stable white or gray crystalline solid with a sweetish odor. It is used in shells and in recent years has been put up in small cartridges to fit into a fountain pen gun In very dilute concentration, this gas is extremely irritating to the eyes and produces a copious flow of tears. It is not frequently that a permanent harmful effect is produced by casual exposure to this gas; however, if it is blown into the face from a gun, it may be so irritating that ulcerations of the eyeball may occur.

Sickening Gas.—Diphenylamine chlorarsine or "Adamsite," commonly called sickening gas, is almost six times as heavy as air. While not as poisonous as some of the other gases, it has a specific action upon the vomiting center in the brain. Consequently, the nausea and vomiting it produces incapacitates a

person for the time being It is manufactured extensively for mob violence use

ANESTHETICS

Chloroform —Chloroform is a heavy colorless liquid with a characteristic odor and sweet taste It is non inflammable It is very irritating when applied to the mucous membranes or to the skin While it is still used somewhat as an anesthetic other sub stances have replaced it, and in modern hospitals it is rarely employed As an anesthetic, it is very rapid in its action, a few drops on a mask will produce unconsciousness The margin of safety is small it is a dangerous drug to use, and its use should be limited to those who have had extensive training and experi ence in this field Due to its quick action it has at times been employed to commit a murder This is usually done by pouring a considerable quantity on a cloth and holding it over the victim s face Under such conditions the gas is so concentrated that the breath is shut off and death from asphyxiation takes place rap idly

Some persons particularly children are very susceptible to poisoning from chloroform This produces jaundice and death a few hours after its administration An autopsy will reveal a fatty degeneration of the liver sometimes the degeneration will also be found in the kidneys and heart Chloroform is sometimes taken by mouth accidentally or with suicidal intent When taken into the mouth it produces abdominal pain, vomiting and sometimes diarrhea By mouth the fatal dose is probably about one and one half ounces

Ether —Although ether has been used as an anesthetic for over 100 years it was in rather common use as an intoxicant for a long time before the discovery of its anesthetic properties It is a colorless volatile liquid with a characteristic penetrating odor It is highly inflammable, when the fumes are mixed with air an explosive mixture is produced It is probably used more than all other anesthetics combined It has the advantage of a comparatively wide margin of safety and in trained hands deaths due to its use are rare When death does occur it usually is under deep anesthesia, due to paralysis of the breathing mechanism

Occasionally persons will become ether addicts secrete them

selves in their rooms and inhale the fumes Ether, when taken by mouth, produces a strong burning sensation in the throat and stomach, and intoxication very similar to that caused by alcohol is produced The fatal dose of ether is impossible to determine accurately Due to the irritating effects of ether upon the air passages, bronchitis, pneumonia and similar lung conditions may be produced Therefore, if it is necessary to anesthetize a person having a severe sore throat or bad cold, it is often wise to employ another anesthetic

When death follows ether inhalation, autopsy findings are not characteristic The internal organs smell strongly of ether and the blood is usually fluid with darkening and congestion of the viscera

Ethyl Chloride —This is a colorless volatile liquid with a burning taste When spread upon the skin in a fine stream, it evaporates so rapidly that it freezes the surrounding tissues and produces enough local anesthesia for minor operations such as lancing a boil The drug is often used as a general anesthetic It has the advantage of very rapid action so that a few breaths are sufficient to produce unconsciousness For short operations such as puncturing an ear drum or setting a broken bone, it is very useful, but the drug should never be used if a longer operation is contemplated

When a longer operation has been attempted, cases of poisoning with a high proportion of fatalities have been noted These deaths are apparently due to depression of the breathing center in the brain At autopsy there are no characteristic findings The blood is usually fluid and the organs congested.

Nitrous Oxide —Nitrous oxide is known as "laughing gas" and is commonly used in both the dental and medical professions It produces anesthesia simply by depriving the patient of oxygen, so that unless a certain amount of oxygen is given with it, usually 15 or 20 per cent, death may result from asphyxia The postmortem findings are similar to those due to asphyxia from other causes

Ethylene —Ethylene has been used considerably in past years as an anesthetic When in solution in the blood stream, it apparently has a direct effect on the nervous system and produces unconsciousness It has the disadvantage of being highly explosive, and some fatal accidents have been reported from

operating room explosions, where a spark of static electricity or an open flame has caused the ignition

Cyclopropane—This gas has been employed during recent years because of its remarkable anesthetic action with but comparatively little depressing effect upon the circulation In low concentrations it is not irritating and the blood pressure remains normal An adequate amount of oxygen must be given with it Like ethylene, it also has the disadvantage of being a highly explosive mixture when oxygen is added Consequently precautions must be taken against static sparks or the use of an open flame or cautery in the operating room

Avertin—This drug is mixed with water to make up a 3 per cent solution and is administered in the form of an enema A few minutes after injection the patient loses consciousness and becomes more or less deeply anesthetized depending upon the amount administered in proportion to body weight In cases of poisoning the drug produces severe depression of the breathing and blood circulation The color of the skin becomes very dark and death may result unless measures such as stimulating the respiration and giving oxygen, are promptly taken

Sodium Penthothal—This drug exists in the form of a crystal and is employed by dissolving it in water and injecting it into a vein During the last ten or more years its use has become widespread The drug is one of the derivatives of barbituric acid, and as such is related to the common sleeping tablets When injected into a vein it produces unconsciousness rapidly and, if oxygen is used with it anesthesia may be maintained safely for a considerable length of time It has the advantage of being rapidly eliminated by the body, so that the patient recovers consciousness soon after the injection is stopped It is likely that most deaths due to its use are caused by insufficient oxygen being administered with it Asphyxia is produced with its characteristic autopsy findings

CORROSIVES

This group of poisons produces a lethal effect principally by means of a destructive local action in the mouth, throat and stomach

STRONG MINERAL ACIDS

The most common acids which are encountered in medico

legal work are *nitric, muriatic or hydrochloric, sulphuric, oxalic, carbolic and other phenol derivatives* All of these acids, when taken in strong solution, produce an intense burning of the mouth, throat and stomach, with considerable destruction of tissue In nearly all cases, a certain amount of the acid is regurgitated from the mouth and nose, leaving burns on the skin around these areas or where it has run down over the cheek

Following the swallowing of these substances, the pain is agonizing and vomiting almost always follows The tongue may be so swollen that it fills the mouth The flow of saliva is profuse, causing drooling due to the inability of the victim to swallow The vomitus is very acid and may be blood stained, it may contain pieces of the mucus membranes of the esophagus and stomach There is an expression of deep anxiety the skin is clammy eyes sunken, breathing difficult, and extremities convulsed *Death in coma, asphyxia, or convulsions* may follow shortly or may be delayed for several days If carbolic acid or any of the other phenol derivatives have been swallowed the characteristic odor will be strong and persistent

FIG 112 Suicide by drinking carbolic acid Note the burning of the skin of the face and chest due to the regurgitation of the caustic material (Courtesy of C W Muehlberger)

STRONG ALKALIS

Lye, sodium hydroxide and caustic potash are the common members of this group Most of the cases of poisoning are suicidal or accidental When the corrosive is taken by mouth, the symptoms are a burning pain in the pit of the stomach and the vomiting of blood stained and brownish material Death may occur in shock within a few hours

Many cases are on record of lye having been swallowed by children If death does not take place within a day or so they may recover from the immediate effects of the corrosion pro duced in the mouth and throat When healing takes place, however, so much scar tissue is produced that the esophagus may be greatly constricted or even entirely closed These cases are pitiful as it often requires the making of a permanent open ing through the abdominal wall into the stomach to feed the patient Dilute solutions of *sodium hydroxide* have been injected accidentally into the bladder or ureters by mistake during the examination of the urinary tract, and have caused death by their corrosive action

Household ammonia has an action similar to that of lye and caustic potash, and the postmortem appearance and autopsy findings are much the same The fatal dose is variable but has been as little as one teaspoonful At autopsy, the characteristic pungent odor will serve to identify it

METALLIC POISONS

With few exceptions, the metals of this group have common characteristics when taken internally, namely, *burning of the mouth and throat, abdominal pain, vomiting and severe diarrhea* In comparison to most other poisons, the metals are rather slow acting and it is seldom that a metallic poison will kill a person within a few hours In many instances it requires several days and often two or three weeks

Arsenic —Arsenic is probably the most common poison ad ministered for the purpose of murder It can be purchased in many forms from stores dealing in drugs and garden and nursery supplies Nearly every farmer has arsenic in some form on hand for use in spray materials For criminal purposes the most com mon form is probably arsenic trioxide, also known under the names of white arsenic, arsenious oxide or ratsbane Other com mon forms of arsenic are the aceto arsenite of copper, commonly known as Paris Green, also lead arsenate and calcium arsenate

Arsenic is likewise extensively used in medicine Fowler's solu tion is a dilute arsenical preparation which has been widely used for years Effective agents formerly employed in the treatment of syphilis are arsenicals in the form of arsphenamine (salvar san), neoarsphenamine and mapharsen

Arsenic works both by producing violent irritation by direct contact with the mouth throat and intestinal tract, and also by the formation of arsenous acid in the tissues Irrespective of the form in which arsenic is taken it is the formation of this arsenous acid which produces the delayed and devastating effects of arsenic poisoning

Acute Arsenic Poisoning—Acute arsenic poisoning is caused by the taking of a large single dose of arsenic and in criminal cases is usually in the form of arsenic trioxide There is burning of the mouth and throat, followed by severe abdominal cramps associated with nausea and vomiting The vomited material may at first consist of food and some of the swallowed arsenic Later bile, blood or clear fluid follow Diarrhea soon sets in with colicky pains The material at first is similar to usual diarrhea stools but later may be followed by considerable amounts of mucous shreds and blood Under such conditions of vomiting and diarrhea, the fluid loss from the body is great The urine becomes very concentrated and thirst is intense The victim exhibits the characteristics of profound shock The skin and extremities are cold and clammy the pulse is weak and respirations are of a sighing character Convulsions may or may not appear before coma and death take place

This series of events may all take place within a few hours but generally death is delayed for two or three days or longer If there appears to be a large amount of food in the stomach at the time the arsenic is taken, a considerable amount of the arsenic may be vomited, so that while the victim shows the symptoms of acute arsenic poisoning he may linger for several days before death occurs or at that time may begin to show signs of recovery With homicidal intent he may be given another dose at about that time and it is not uncommon to find in cases of murder by the administration of arsenic that repeated doses have been administered before death takes place

Chronic Arsenic Poisoning—If the victim is still alive after taking a single large dose of arsenic within a few days symptoms of chronic poisoning may appear More often, however, chronic poisoning follows the repeated administration of small doses and is occasionally seen in cases of arsphenamine poisoning where the symptoms have not been recognized by the doctor and repeated injections of the drug have been given In

chronic arsenic poisoning, in addition to the diarrhea and abdominal pains, there is usually swelling of the eyelids and symptoms resembling those of a bad cold, such as sneezing, hoarseness, nasal discharge and cough These symptoms are produced by an inflammation of the mucous membranes of the nose and throat The poison may affect the liver, producing jaundice The skin is often affected and exhibits a generalized eruption with a peeling off in flakes especially on the hands and feet The hair may fall out and finger nails become loose

Where arsenic poisoning has been prolonged over a considerable period of time it may also seriously affect the nerves, particularly of the arms and legs Severe pains in the extremities are observed and paralysis may result Finally, the victim may develop an apathetic listless condition and death may follow due to exhaustion and malnutrition

Autopsy Findings—At autopsy, if death occurred a considerable time after the original administration of the arsenic, the most characteristic lesions will be fatty degeneration involving the liver and kidneys

There will also generally be found inflammatory and ulcerative changes in the stomach and particularly in the small intestine These ulcerations are limited to the small intestine, the large intestine does not seem to be affected ***This is an interesting diagnostic point in differentiating arsenic poisoning from mercury poisoning*** The same type of ulcerations occur in mercury poisoning with the exception that they are found only in the large intestine and the small intestine is free

The bodies of persons dying from arsenic poisoning are apt to be well preserved, as arsenic is an excellent preservative of the tissues For instance, the body of a person whose death, as it was found, was due to arsenic poisoning was autopsied three years after burial The state of preservation was excellent It was possible to get good sections of the brain and other tissues which ordinarily are completely destroyed much sooner by putrefactive changes Years ago arsenic was one of the principal ingredients of embalming preparations However, at present its use is prohibited by law, because it is impossible to detect arsenic in a body if the same ingredients are used in the embalming fluid Arsenic preparations are not destroyed in the tissues by modern

embalming processes, nor are they destroyed by ordinary putrefactive changes Therefore, if a person has suffered death due to arsenic poisoning, it is usually possible to detect it even though the body may have been buried for several years The same is true of all other metallic poisons

It is rather rare that poisoning by arsenic or one of the other metallic poisons is suspected at the time of the victim's death, and months or years may elapse before circumstances present themselves which begin to cause suspicion that possibly a homicide has been committed In such cases the most important thing for the investigating officer to do is to try to obtain a full and complete history of the illness preceding death The chief symptoms to be on the watch for are *abdominal pain, vomiting, severe diarrhea, weakness and prostration,* and finally death from an illness usually lasting from two or three days to a month If such a history is obtained, steps should then be taken to have the body disinterred and an autopsy performed In any such autopsy, adequate or large portions of the liver, kidneys, brain, heart, lungs should always be taken for chemical analysis If the autopsy is performed shortly after death, it is very helpful to obtain a specimen of urine if the bladder still contains some If the deceased was sick for several weeks before death, an adequate specimen of hair should also be taken

The fatal dose of arsenic is uncertain, however, cases are on record of quantities as small as a grain and one half having caused death

Mercury.—Mercury poisoning is remarkably similar to that produced by arsenic For some reason it seems that, barring the cases of accidental poisoning, deaths due to taking mercury are almost always suicidal, while those due to taking arsenic are usually murder Mercury is used in a large variety of medical preparations such as antiseptics and mercury salicylate which is given in the form of injections into the buttocks in the treatment of syphilis There is also calomel, and various ointments such as ammoniated mercury which is used in the treatment of various skin conditions Poisoning by these preparations sometimes occurs, but it is not often that the results prove fatal

By far *the most common mercury preparation encountered in medicolegal work is bichloride of mercury or "corrosive sub-*

limate " This is purchased in the form of tablets for the preparation of disinfecting solutions These tablets may be swallowed or taken in solution Cases of fatal poisoning have resulted from using the solution as a douche There is a case on record of a boy of eighteen who discovered symptoms in a family doctor book which led him to erroneously believe that he had gonorrhea He dissolved two of the bichloride tablets in a small amount of water and injected it into the urethra causing his death a few days later

About twenty years ago, the swallowing of bichloride of mercury was a very common form of suicide It actually is about the worst form of suicide that one could choose, as the suffering is intense and apt to be prolonged for a period of a week or ten days

The immediate symptoms of mercury poisoning are intense burning of the mouth and throat even more severe than in the case of arsenic This is quickly followed by violent abdominal pain nausea vomiting and later diarrhea The kidneys are seriously affected, the urine may be very scanty and concentrated and after several days the kidneys may entirely cease to function The mouth is swollen and ulcerated and the breath has a foul odor Death usually takes place in a week or ten days

Autopsy Findings —When bichloride of mercury is taken by mouth the mucous membranes of the mouth esophagus and stomach may present a dark corroded appearance Extensive ulcerations are usually found in the large intestine while the small intestine is singularly free of them The kidneys show acute inflammatory changes At autopsy, adequate specimens of the organs should be removed for analysis as was mentioned under arsenic poisoning The fatal dose may be small, probably as low as 3 to 5 grains of bichloride of mercury If large amounts of bichloride are taken by mouth on an empty stomach death may take place within an hour or two but more often the illness lasts a week or longer

Lead —Lead poisoning is seldom encountered in criminal investigation, it is usually accidental and frequently is of industrial importance Persons who are exposed to lead in their work such as painters plumbers, linotype operators, and battery workers are most often affected Lead poisoning is some

times encountered in young children who have chewed off the paint on toys or furniture In cases of acute lead poisoning, which are rather uncommon, the symptoms are similar to those caused by arsenic, namely, abdominal pain associated with nausea, vomiting and diarrhea Chronic lead poisoning is insidious in its onset, the most characteristic symptoms being colicky pain in the abdomen, weakness, loss of appetite, loss of weight and anemia A dark blue line forms along the gums and weakness develops in the arms which eventually leads to paralysis known as "wrist drop" If the symptoms are recognized in time and proper treatment given, most patients will recover, though it may be several months before their health is restored

Autopsy Findings—In cases of acute poisoning followed by death, the most characteristic symptoms are inflammatory reactions in the stomach and intestine, liver and kidneys

Antimony—Antimony poisoning is seldom encountered at the present time Years ago it was much more common and was usually the result of taking tartar emetic The drug is now seldom used Chemically, antimony is closely related to arsenic and is a tasteless, odorless solid with a grayish white appearance When taken internally, it produces symptoms nearly identical with arsenic poisoning, namely, pain in the abdomen, vomiting, diarrhea and prostration Fatalities have occurred from the swallowing of as little as one grain

Autopsy Findings—The autopsy findings are nearly identical to those found in arsenic poisoning, however, the lining of the stomach and intestines may show a yellowish to reddish discoloration caused by the presence of antimony compounds

Phosphorus—Phosphorus is encountered in two common forms One is the poisonous white or yellow phosphorus which is easily ignited at a temperature of 122 degrees Fahrenheit, and has the taste and odor of garlic

The other form is red phosphorus, which is comparatively non poisonous Yellow phosphorus at one time was freely used in the manufacture of matches, but at the present time red phosphorus is used instead However, yellow phosphorus is occasionally used in the manufacture of fireworks, rat poisons (pastes), and gun powder Industrial poisonings sometimes occur in factories manufacturing these articles

When taken internally, phosphorus produces a burning sensation in the throat, a garlic like taste in the mouth abdominal pain and intense thirst This is shortly followed by vomiting and purging The vomitus sometimes contains blood, has a garlic like odor and glows in the dark The victim is profoundly shocked and death may result from collapse

If death does not follow within a few hours, the patient for a time may seem to be improved, only to become jaundiced because of fatty degeneration of the liver The patient gradually sinks, the heart action becomes feeble delirium, convulsions coma and death follow Three grains of the yellow or white phosphorus is generally regarded as a fatal dose and the fatal period may vary from an hour or two to several weeks

Autopsy Findings —When death soon follows the swallowing of the phosphorus there will usually be found extensive destruction of the lining of the throat esophagus and stomach with ulceration and even perforation The stomach contents may phosphoresce and the characteristic garlicky odor is noticed Hemorrhages may be found in the pleura and pericardium and, in some cases, on the surface of the brain

If death has been delayed several days or weeks there is a characteristic degeneration of muscle and glandular tissue This is found chiefly in the kidneys liver and muscles The heart seems to be particularly affected

LESS COMMON METALLIC POISONS

Bismuth —Bismuth is often injected into the buttocks for the treatment of syphilis It is also used extensively in medicine in the treatment of gastritis gastric ulcer and diarrhea In general, large doses of bismuth taken by mouth are harmless, but occasionally, under extraordinary circumstances, poisonous effects may be produced When poisoning does occur, it follows the pattern of metallic poisons generally, and may and usually does end in convulsions, coma and death Evidence of liver and kidney degeneration is the most characteristic finding at the autopsy

Thallium —Thallium has been used in rodent poisons, cosmetic preparations for the removal of excess hair, and in medicine for the treatment of various skin infections and is some

times given internally to reduce the night sweats of tuberculosis When poisoning occurs, the onset of symptoms is usually a day or so after the drug is taken The first indications noticed are tingling sensations and pains in the hands and feet Later occur severe abdominal cramps and vomiting, prostration and inflammation of the mouth and gums with a bluish line appearing at the gum margin A few days later, the victim shows evidence of paralysis of certain muscles about the head and face, the hair falls out, and death usually occurs about the tenth day

Chromium —Chromium compounds are extensively employed in industry by dyers and furriers, battery manufacturers, and electroplaters When taken by mouth, chromium compounds produce poisoning which follows in the general pattern of other metals

Copper —Copper is widely used in industry, and poisonous symptoms are generally produced by three common compounds namely, copper sulphate, copper acetate and copper arsenite When taken internally, copper acts as a powerful irritant Violent vomiting followed by abdominal pain and severe purging is induced The vomitus and stools are green colored Later, headache, collapse, paralysis, delirium and death may follow If the victim lives for several days after the poisoning, jaundice may be marked

Postmortem examination will disclose the usual findings produced by other metals, and, in addition, the lining of the intestinal tract may have a bluish appearance due to the presence of copper compounds

ORGANIC POISONS

The organic poisons are those which are extracted from various plants, and for purposes of convenience are classified under two main groups, the ***alkaloids*** and ***non alkaloids***

ALKALOIDS

The alkaloids are organic compounds which chemically have the characteristics of alkali Just as the heavy metals have certain common properties when taken internally, so the alkaloids exhibit certain common factors They are, principally, that ***the alkaloids are extremely poisonous in very small quantities and***

kill quickly They exert their principle effect upon the nervous system

Strychnine—Strychnine poisoning is usually suicidal, however, it is not infrequently accidental This happens occasionally when children have eaten cathartic tablets which may contain small amounts of strychnine Formerly this drug was extensively used as a heart stimulant but, at present, it has largely given way to better and less toxic preparations The adult dose of strychnine sulphate, when given as medicine, is 1/60 to 1/30 of a grain

When taken in larger quantities and poisoning occurs, the first symptoms are intense restlessness, and a tightening of the face muscles Because of the irritating action of strychnine on the spinal cord, muscular twitchings which shortly lead to generalized convulsions follow The convulsions become so severe that the spine becomes arched with the head drawn back so that the entire weight of the body is borne on the heels and the back of the head The victim's mind usually remains clear, but the convulsions become so intense that breathing is interfered with and the skin becomes very dark blue and gray The convulsions last a minute or so, followed by an interval of relaxation which may last for several minutes, only to reoccur As the convulsions become more severe, the respirations eventually cease entirely and death follows Death from strychnine is very similar to death from lockjaw, except that it is much more rapid

In one case that I observed personally, death followed in about fifteen minutes after taking the poison Depending upon such factors as the amount of strychnine taken and the amount of food in the stomach, the onset of symptoms may be slowed, and if proper measures are promptly taken, the patient's life may be saved A quarter of a grain of strychnine sulphate has caused death, while many persons will survive the taking of much larger quantities

Nicotine—In its pure form, this drug is a colorless oil It is derived from tobacco and is used principally as the poisonous ingredient of insecticide sprays When taken in poisonous doses, it produces a burning sensation in the mouth, throat and stomach accompanied by a feeble, rapid pulse and labored respirations Convulsions may appear and death follow rapidly

Nicotine is readily absorbed through the skin and several cases have been reported of serious poisoning due to spray materials being spilled on the clothing The fatal dose is very small, probably as low as one grain

Belladonna Group —The principal drugs of this group are *atropine* and *scopolamine* or *hyoscine,* they are extremely poisonous These drugs are used extensively in medicine and poisoning may occur from the administration of the drug by mouth or by absorption through the skin when used in plasters, ointments or liniments

The first symptoms of poisoning are dilatation of the pupils a dry throat and a mild delirium Later this is followed by collapse and coma with death occurring shortly

Hyoscine and *scopolamine* are identical in their actions and formerly were used under the name of *truth serum* on persons suspected of having committed crimes of a serious nature (See Chapter 6) These drugs affect the nervous system with a curious combination of stimulation and depression The face becomes flushed the pupils dilated and a mild delirium is produced When the drug wears off there is usually no recollection of anything that happened while the patient was under its influence

Scopolamine was also employed at one time in conjunction with morphine to produce *twilight sleep* for painless childbirth Large doses carry considerable danger to both mother and child and it is not used as frequently for that purpose at the present time

Death from these poisons usually takes place within 24 hours although occasionally a longer time is required Death is due to paralysis of respiration The autopsy findings are characteristic of asphyxia

Opium Derivatives —Opium is the dried juice derived from the unripe poppy capsule and from this product several important drugs are manufactured The most common are *morphine, heroin codeine papaverine, paregoric* and *laudanum* Opium and all of its derivatives have certain properties in common The most characteristic of these is their ability to relieve pain and induce sleep However they are also employed extensively in cough preparations and for relieving diarrhea cramps and similar conditions These drugs are also of

particular importance in the medicolegal field, because of their tendency to be habit forming While there is a great range in the habit forming properties of these derivatives, none of them is without a certain amount of danger if used continuously over a protracted period

Morphine —Morphine is extensively employed in medical practice and is often referred to as "the indispensable drug" Practically every doctor carries morphine in his bag and uses it frequently Its action is similar to that of the opiates generally in its ability to relieve pain and induce sleep When taken in excessive amounts it will produce very deep slumber, the pupils become constricted until they resemble pin points respirations become exceedingly slow and death may take place from paralysis of the breathing center In some cases convulsions may precede death, the skin becomes dark blue and clammy Morphine poisoning may be confused with alcoholism, apoplexy or coma from taking sleeping tablets

Morphine, when taken either by mouth or by hypodermic injection, is secreted into the stomach Thus, it may be necessary to wash the stomach and analyze the washings to make a differential diagnosis The fatal dose of morphine in an adult is probably one to two grains when taken by hypodermic and somewhat more than that when taken by mouth Children are much more susceptible to poisoning by morphine than adults The autopsy findings consists of edema (water logging) of the lungs and brain The pupils are usually contracted, although in some cases dilatation of the pupils takes place just before death

Morphine is the drug most commonly employed by narcotic addicts probably because it is the drug most available Addicts build a tolerance for the drug so that in some cases the amount taken in a day may be several grains In some cases the use of as much as 50 grains per day has been reported

Addicts almost never take the drug by mouth, because it is less effective than by hypodermic injection It is not uncommon that the drug will be injected directly in the vein at the elbow so as to get the complete effect of the morphine in the shortest possible time

The general conception of the morphine addict as a sallow

appearing individual is not necessarily true Many of them appear to be in the best of health and in some cases will take small quantities daily for years, carry on their business and con duct themselves without even their friends realizing that they are addicted to the drug

Heroin —Heroin is the most pernicious of the habit forming drugs, and for that reason its manufacture has been prohibited in the United States for over 20 years At present practically all of the heroin employed by addicts has been smuggled in from foreign countries

Codeine —Codeine is one of the least harmful of the opium derivatives from the standpoint of its habit forming character istics Ordinarily, one can take small quantities of codeine for a considerable period of time without developing any abnormal craving for the drug The effect of codeine is quite similar to that of morphine but much less potent It is frequently used in cough preparations Poisoning from the drug is quite similar to that produced by morphine

Other Alkaloids —*Aconite*, a drug once widely used in medi cal practice, is now rarely employed When taken into the mouth, it produces a tingling sensation followed by numbness and loss of sensation In poisonous doses there is the tingling sensation previously mentioned, followed by nausea and vomit ing The skin is cold and damp, the pulse is weak and convul sions may follow Death ensues due to failure of breathing

Aconite is one of the most deadly poisons known Deaths have been reported from amounts of only one hundredth of a grain

Marihuana (hashish), Cannabis sativa —This is the common hemp plant that for decades has been grown commercially in the United States for its fiber In many parts of the world, par ticularly in the sub tropics the drug has been used for smoking During the last twenty five years this practice has appeared in this country and an enormous amount of publicity has been di rected against it

At one time, extracts of the plant were commonly used in medical practice but are rarely employed at present The reason for the recent interest in marihuana is the supposition that its use was frequently associated with murders or other

FIG 113 Marihuana (*Cannabis sativa L*) This plant grows luxuriantly in many sections of the United States

serious crimes Most states have enacted legislation making it a serious offense to grow the plant and there is a federal statute prohibiting its possession or use

When the leaves or flowering tops are smoked in a pipe or in the form of a cigaret, there is a wide variation in the symptoms exhibited by the smokers These range from headache to delirium and a narcotic type of slumber Whether or not a true addiction for the drug is often developed is questionable While cases have been reported of serious crimes having been committed by persons under the influence of marihuana, in the experience of the Michigan State Police, there is no authentic record of such an occurrence

NON ALKALOIDS

Chloral Hydrate—This drug exists in the form of white crystals and is used in medical practice for quieting the nervous

system and inducing sleep This drug is also known in the underworld as *knockout drops* It derives this name from the fact that it is used for robbery purposes to "knock out" the victim by placing it in his liquor In ordinary doses chloral hydrate causes a very natural type of slumber, but in poisonous doses sleep is so deep that the victim cannot be aroused Respirations are shallow, the pupils may be contracted and the skin very blue Occasionally convulsions precede death, which is due to failure of breathing The fatal dose is variable, ranging from two to thirty grams

Barbituric Acid Group (Hypnotics) —Like chloral, the drugs belonging to this group are used for producing sleep and the quantity annually consumed in the United States is enormous Practically every drug house makes a preparation belonging to this group and sells it under its own trademark Among the many drugs which are closely related are *barbital, nembutal, amytal, ipral, phenobarbital, seconal,* and several others These drugs induce sleep and are chiefly of interest in the medicolegal field when they are taken with suicidal intent This group of drugs has a wide margin of safety, and many times the usual therapeutic dose can be taken without causing death However, it is probable that the fatal dose lies somewhere between eight and ten grams

The symptoms of poisoning from drugs of this group are unconsciousness, slow and shallow breathing, low blood pressure and blueness of the skin

When a person is seen profoundly poisoned by drugs of this group, *one should be very careful not to conclude that death has already taken place* I recall one instance in which two nurses entered into a suicide pact and between them swallowed one hundred capsules of one of these drugs When they were discovered, they were presumed to be dead The coroner was called, he likewise pronounced them dead and proceeded to remove the bodies to the morgue While the bodies were being loaded into the basket, a state trooper thought he detected signs of life in one of them, with the result that they were transferred to a hospital Both eventually recovered, but a serious mistake was narrowly averted

Some persons develop an addiction for drugs of this group

which is usually much milder that the addiction developed for the opiates They are also used frequently by alcoholics when they have reached the stage of nervousness and tremors Some authorities believe that accidental death occasionally results due to the fact that while a person is under the influence of barbiturates he may take a large overdose of the drug without realizing what he is doing It is possible that this sometimes happens but I doubt if it is nearly as frequent an occurrence as some believe This phenomenon is called *automatism*

Paraldehyde —Paraldehyde is a colorless liquid with a penetrating, disagreeable odor It is irritating to the mouth and stomach and for this reason is usually introduced by rectum It produces sleep in the same manner as chloral Due to its wide margin of safety, poisoning is not common, but when it does occur, it is characterized by convulsions, high temperature weak pulse and profuse sweating The fatal dose is uncertain but there are reports of recovery after taking as much as one hundred grams

Alcohol —Alcohol belongs in the class of non alkaloids but due to its importance in the medicolegal field, a special chapter is devoted to this drug See Chapter 13

Carbon Tetrachloride —Carbon tetrachloride has a wide variety of uses, both in industry and in medicine In industry, it is employed extensively as a solvent for greases and rubber, as a fire extinguisher, and as an ingredient of certain paints In medicine, it has been used as a treatment for hookworm, as well as other purposes

Carbon tetrachloride becomes hazardous in industry when its vapors reach a concentration of over 01 of one per cent When used as a fire extinguisher, the heat may produce the formation of phosgene and cause serious poisoning

Symptoms of poisoning are similar to mild alcoholic intoxication, followed by stupor and slumber Death may follow several hours later, due to damage to the liver A fatal dose ranges from about one teaspoonful upwards

FOOD POISONING

Food poisoning is almost always accidental For years it has been improperly called *ptomaine poisoning* Actually the poison

ing is not due to ptomaines, but is due to eating spoiled or contaminated food. Because of the great improvement in refrigeration during the past few years, this type of poisoning is becoming less common, although it is still of frequent occurrence.

Poisonous Food.—One of the most common types of poisoning due to eating a toxic substance occurs in the case of poisonous mushrooms Certain varieties of mushrooms are never poisonous, some are always poisonous, while others are toxic only at certain seasons The first symptoms of mushroom poisoning are severe abdominal pain, vomiting and diarrhea. The suffering is severe and the vomitus and stools may contain blood. There may be jaundice, blueness of the skin and unconsciousness. Death may occur within 24 bours or be delayed for several days.

Poisoning by Spoiled or Contaminated Food.—

Botulinus Poisoning.—This is caused by eating food whicb has been contaminated with the botulinus bacillus It is a deadly type of poisoning The first symptoms may be headache, muscular weakness, and dimness of vision. Frequently constipation is an outstanding complaint. Later there develops difficulty in swallowing and talking and an inability to speak Extreme muscular weakness develops, tbe pulse becomes very rapid, with the temperature below normal Respiration becomes very labored. Death due to asphyxia results, usually in from four to six days, altbough it may be delayed for a considerably longer time.

Ptomaine Poisoning.—As previously stated, *ptomaine* is an improper term to use with respect to this type of poisoning, *as the poisoning is due not to ptomaines but to bacterial spoiling.* Usually there are several people affected, depending upon bow many ate the tainted food, and *it is most common where food is prepared some time in advance.* Church suppers used to be notorious for the outbreaks of this type of poisoning Poisoning is also apt to occur when refrigeration has heen faulty, and it has been known to he caused by ice cream which has melted and then been refrozen.

Usual symptoms are ahdominal pain, nausea, vomiting and

diarrhea If the cause of the poisoning is discovered in time and proper treatment given, death seldom follows

Unclassified Poison —Sodium Fluoride —This poison exists in the form of a white powder and is widely used in the manufacture of roach powder Poisoning is usually accidental due to its being mistaken for baking powder or some other ingredient in the preparation of food

Poisonous doses cause vomiting and diarrhea, shallow and rapid respirations, finally ending in convulsions, coma and death The skin is bluish and covered with cold, clammy perspiration Mottling of the teeth has been noted in cases of chronic poisoning, particularly in children

MODERN INSECTICIDES

During the last decade a new group of insecticides has been developed which have largely replaced the arsenic and flourine compounds which were formerly used This new group is known as the *chlorinated hydrocarbons* and are poisonous to a high degree

These insecticides affect principally the nervous system but also include injury to the liver and kidneys

DDT —During recent years this chemical has been a widely used and readily available commercial insecticide When used as intended it is harmless but when swallowed accidentally or with suicidal intent it may cause death Only a few fatal poisonings have been reported up to this time In one instance a 10 months old infant died within four hours after swallowing 30 cc of a 5 per cent mixture of DDT in kerosene In another case a 58 year old man died $6\frac{1}{2}$ days after he accidentally drank 120 cc of a 5 per cent solution of DDT Although he realized his mistake at once and drank a quart of milk immediately in an hour he developed severe abdominal pain and vomiting The vomiting continued and the vomitus changed from dark brown to bright red Although he was admitted to a hospital he gradually grew worse and died Autopsy revealed erosion and bleeding from the lining of the stomach, congestion of the lungs, and degeneration of the kidneys and liver ***Chlordane*** is one of the most toxic of the chlorinated insecticides and is employed principally for the con

trol of ants and grubs Its poisonous action is similar to that of DDT

Toxaphene —Toxaphene is used in the control of grasshoppers and for insects of livestock It is even more poisonous than DDT

Other insecticides belonging to the chlorinated hydrocarbons are *Lindane Aldrin Dieldrin Methoxychlor Heptachlor* and *TDE*

At present practically all cases of poisoning by the chlorinated hydrocarbons have been accidental It seems likely that due to their high toxicity and easy availability they will become more important in homicide investigations

MEDICAL NOTES ON POISONING

In attempting to isolate and identify poison in a dead body two questions confront the toxicologist These are

1 *Is embalming likely to interfere with the analysis?*

2 What is the tendency for poison to disappear in the dead body?

Difficulties Caused by Embalming —The usual embalming fluid consists of about 40 per cent formaldehyde and about 10 per cent methyl alcohol When a body has been embalmed the detection of any poison is rendered more difficult and the analysis of certain poisons is made practically impossible For instance when deaths are due to cyanide or alcohol it is impossible to detect these poisons after embalming The detection of organic poisons is made much more difficult that of heavy metals is affected least of all

If one desires to determine whether certain poisons have caused death and for some reason it is inexpedient to do an autopsy the wise procedure is to obtain a sizable sample of blood at the time of embalming As the embalming fluid flows by pressure into the blood vessels the blood is drained off and at least *the first portion of blood recovered* will *not* be contaminated by embalming fluid if care is taken to collect the blood from the opposite side of the body from where the fluid is injected Often it is possible to obtain a sufficient quantity of blood from the vein before any fluid has been injected Be sure to collect the specimen in a ***new,*** clean glass bottle or jar Con

sequently, it is possible to run determinations for many poisons on this blood Particularly carbon monoxide and alcohol can readily be determined by analyzing this blood collected at the time of embalming

Disappearance of Poison in the Dead Body—In poisoning cases, the question frequently arises as to the likelihood of finding poison in a body that has been buried for a considerable period of time Some poisons disappear rapidly after death, while others may be found after several years It is impossible to set up any definite rule as to the likelihood of finding poison in an exhumed body, but if there are any reasonable grounds to believe that the deceased came to his death by criminal poisoning the body should be exhumed and an attempt made to discover the actual cause of death

The poison which disappears most rapidly is cyanide, while the alkaloids being more resistant to oxidation, remain from a few days to a few weeks Of the alkaloids the opium derivatives disappear most rapidly atropine and hyoscine more slowly, while strychnine is the most resistant and may remain as long as three months or longer Carbon monoxide may be detected after a much longer period The heavy metals are very resistant and often can be recovered years after death In one instance, I autopsied a body which had been buried more than three years Large quantities of arsenic were found and a conviction for first degree murder was obtained Cases are on record of arsenic recovered ten years after burial *In general, it may be said that if there is reason to believe that death was caused by metallic poisoning, it is always worth while to exhume the body If an alkaloidal poison is believed to have caused death and if the body has been buried longer than three months, exhumation is seldom worth while* However, if strychnine poisoning is suspected it is wise to exhume the body even if it has been buried from six months to a year Failure to recover strychnine under such circumstances should not be interpreted as indicating that the victim did not die of strychnine poisoning

In determining whether or not death is due to poisoning, one must remember that the symptoms preceding death, as well as the external appearance of the body, are of great importance Of course, many poisons will produce some similar symptoms,

but when the outstanding symptom is one of those indicated below, there are definite poisons to look for first. These are classified as follows:

EXTERNAL APPEARANCE AFTER DEATH

1. Livid cherry red color of large areas—*carbon monoxide, cyanide.*
2. Face and neck very dark—*strychnine, hypnotics, aniline, nitrobenzene.*
3. Pupils contracted—*opiates.*
4. Pupils dilated—*atropine, hyoscine (scopolamine).*
5. Emaciation—*metals.*
6. Burns about mouth and nose—*strong mineral acids, strong alkalis.*
7. Characteristic odors—

    Phenols—*carbolic acid*
    Peach pits—*cyanide*
    Garlic—*oxalic acid, phosphorus*

SYMPTOMS PRECEDING DEATH

1. Convulsions—*strychnine, nicotine.*
2. Delirium—*atropine, hyoscine (scopolamine).*
3. Extreme drowsiness—*opiates, hypnotics.*
4. Extreme rapidity of death—*cyanide, strychnine, nicotine.*
5. Long delayed death—*metals.*
6. Abdominal pain—*metals, food poisoning, chlorinated hydrocarbons*
7. Diarrhea—*metals, food poisoning.*
8. Vomiting—*metals, food poisoning, DDT.*
9. Burning of mouth and throat—*corrosives, mercury, arsenic.*

INSTRUCTIONS FOR THE SUBMISSION OF MATERIAL FOR TOXICOLOGICAL ANALYSIS

The late Dr. Joseph T. Walker of the Massachusetts Department of Public Safety drew up an excellent outline of instructions to coroners and other officials for the submission of material to the laboratory for analysis. This outline is as follows:

"It is of particular importance in cases involving suspected poisoning that considerable attention be given to the matter of the correct choice of material and its preservation before analysis. The opportunity to make this choice under the best conditions comes only once, it should then be done with a view to all of the requirements that might subsequently arise. The material should be properly chosen, it should be abundant and it should be preserved as nearly as possible in its original condition *No artificial preservatives should be added under any circumstances.* It is sufficient to seal the material in jars and keep it cold.

"The best sources of material are those organs of the body through which the poison is ingested, transported, eliminated, or stored The entire stomach and contents should always be taken. Next in importance is the blood, then liver In the case of poisons which affect the nervous system, the brain is a good source of material The kidneys and spleen, although small, serve as receptors for poisons in general Metallic poisons have a tendency to accumulate in the bone, in the horny material, such as the skin, and in the case of arsenic, in the hair and nails. Finally, the contents of the intestinal tract, the urine and the feces will frequently contain large portions of the poison in those cases where death has been delayed

"ALCOHOL.—Alcohol is generally determined on the blood, the brain, the spinal fluid, and, in some cases, the urine or the stomach contents. Any one of the first three materials is sufficient in most cases The blood is the most readily accessible of the three and is very satisfactory. Analysis of the stomach contents, coupled with the analysis of the blood and the urine, may give some information as to the recency with which the alcohol was taken Alcohol is very volatile and consequently material destined for analysis should be placed in containers as soon as possible, sealed with an air-tight seal, and refrigerated. Exposed at room temperature, the material may lose its alcohol content very rapidly. Two ounces of blood should be submitted. The container, regardless of its size, should be completely filled with blood. One half of the brain should be

CONCENTRATION OF POISONS IN VARIOUS ORGANS

	Lungs	Hair and Nails	Bone	Blood	Brain	Heart	Kidneys	Liver	Urine	Intestine	Stomach	Vomitus	Feces	Uterus
Acids (Mineral)				x						xxx	xxx	xxx		
Alcohol				xxx	xxx				xxx		x			
Alkalis				x						xxx	xxx	xxx		
Alkaloids (In general)				xxx	xxx		xxx	xxx	xxx	xxx	xxx	xxx		
Analine				xxx			xxx	xxx	xxx		xxx	xxx		
Antimony			xxx	xxx			xxx	xxx	xxx	xxx	xxx	xxx	xxx	
Arsenic		xxx	xxx	xxx			xxx	xxx	xxx	xxx	xxx	xxx	xxx	
Barbiturates				xxx	x	x	x	xxx	x		xxx	xxx		
Benzene	xx			xxx	xx		xx	xx	xxx					
Cantharidin				xxx			x	xxx	x	xxx	xxx			
Carbolic Acid (Phenols)				xxx	xx		xx	xx	xx	xxx	xxx	xxx		xxx
Carbon Monoxide				xxx										
Carbon Tetrachloride	xx			xxx			x	xx	x	xxx	xxx	xxx		
Chloral Hydrate				xxx	xxx		x	xx	x	xxx	xxx	xxx		
Chlorates				xxx			xx	xxx	xxx		xxx	xxx		
Chloroform	xxx			xxx	xxx		x	xxx	x	x	xxx	xxx		
Cresol				xxx	xx		xx	xxx	xxx	xxx	xxx	xxx		xxx
Cyanide				xxx	x	x	x	xx		xxx	xxx	xxx		
Ergot				xxx			x	xxx	x	xxx	xxx	xxx		
Ether	xxx			xxx	xx						x			
Lead			xxx	xxx			xx	xx	x	xxx	xxx	xxx	xxx	
Mercury			xxx	xxx			xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Morphine				xxx	xxx		xx	xxx	xxx	xxx	xxx	xxx		
Oxalic Acid				x			xx	xxx	xx	xxx	xxx	xxx		
Phosphorus				xxx	xx		xx	xxx		xxx	xxx	xxx		
Strychnine				xxx			xx	xxx	xx	xxx	xxx	xxx		
Nitrobenzene	xx			xxx	x				xxx	xxx	xxx	xxx		

placed in a quart mason jar, tightly sealed and refrigerated Putrid blood is unsuitable for an alcohol determination

"CARBON MONOXIDE —Carbon monoxide blood has very little tendency to clot The cells will therefore tend to separate from the plasma in the blood vessels and organs of the body Since the carbon monoxide is contained in the cells, and not in the plasma, considerable care should be taken in removing the sample of blood to stir the corpuscles thoroughly in order to get a representative distribution of carbon monoxide If the blood is taken from the heart, this may be done by filling the syringe and flushing it back into the heart, then refilling to take the sample Two ounces of blood should be submitted for this analysis A small bottle or vial should be completely filled sealed and refrigerated until delivery to the laboratory Although carbon monoxide is volatile, in many instances it may be recovered from blood of putrified bodies or those recovered from fires

"CYANIDE —The organs should be placed in pint or quart mason jars sealed and refrigerated until delivered for analysis Cyanide is volatile If any drinking glasses, jars or bottles, suspected to contain cyanide, are found on the premises, they should be submitted for analysis immediately If the contents are exposed to the air, they should be protected Either the contents should be removed, placed in a bottle, and sealed, or the original container should be sealed in a suitable fashion

"Accompanying the material submitted for analysis should be the following information

"1 A statement by the medical examiner or coroner authorizing the analysis

"2 The name, address, age and occupation of the deceased

"3 A detailed account of the medical history

"4 A description of the postmortem findings

"5 A list of poisons that are to be searched for

"6 Any additional information that may be relevant to the case"

AN OUTLINE FOR THE SELECTION OF MATERIAL FOR TOXICOLOGICAL ANALYSIS

Feces:	In separate jar.
Vomitus:	Entire in jar.
Stomach:	Entire stomach and contents in pint jar.
Intestine:	Contents only in pint jar.
Urine:	Contents of bladder in pint jar.
Liver:	In quart jar
Kidneys:	Both kidneys in pint jar.
Heart:	In pint jar.
Brain:	In quart jar.
Blood:	Pint or quart jar.
Bone:	Portions of ribs or portions of exposed section of spinal column
Hair:	Considerable quantity from back of head—also toe nails
Lungs:	One in quart jar.

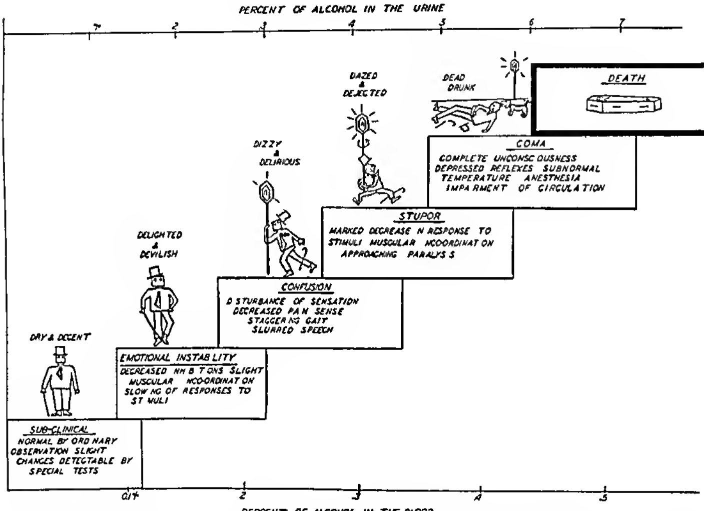


FIG 114 Chart showing *behavior reactions* with graduated amounts of alcohol in blood and urine (Courtesy of C W Muehlberger)

Effect on Human Behavior.—In as much as we are particularly interested in the effect of alcohol upon human behavior, it is impossible to appreciate this action without a basic knowledge of the two important factors governing behavior. It might be said that normal behavior consists of a balance between two opposing forces: one, the mental impulses which are a part of a person's basic personality, the other, the opposing force known as the inhibitions which regulate, direct and keep the impulses in check.

The impulses are a part of a person's inherited characteristics. He is born with them and cannot be detached from them Prehistoric man lived almost entirely by his impulses. He ate when he was hungry, he slept when he was tired and was subject to no outside control whatever. As man developed, expediency forced him to associate with others and live in communities for the purposes of protection, ease in collecting food, his education and his general social welfare Obviously if the impulses of every person remained unchecked, there would be continuous conflict. Consequently, rules and regulations have had to be imposed for the common good of all persons. However, while one is born with no inhibitions, they are gradually developed by family discipline, rules of etiquette, appreciation of the rights of others, and a submission to the dictates of law and order. These being entirely the product of one's training from the time of his birth, consequently they are not nearly so firmly attached to him as are the basic impulses with which he is born

Keeping in mind that the chief effect of alcohol is to slow down and depress the nervous system, what happens when a person takes a few drinks? The alcohol is absorbed from the stomach and intestine into the blood stream where it is carried to all parts of the body, including the brain and nervous system Here the alcohol exerts its depressing influence The first part of the behavior mechanism to be affected is that which is least firmly attached, namely, the inhibitions. As these are slowed down and eventually almost disappear the impulses are left without restraint. Consequently, the first signs of alcoholic intoxication may be undue familiarity, the telling of a story which is out of place, or some other action which indicates that the sense of good manners and the observance of proper behavior is

gone In this condition the person affected feels the freedom from restraint He forgets his worries and cares, and interprets this reaction as stimulation, whereas in fact it is the manifestation of depression

His muscular reactions are definitely slowed and while he feels in tip top condition to drive an automobile or to do any thing else requiring co ordination of muscular movements, he is actually not nearly as accurate as he was before he took the drinks After taking a little more alcohol, his inhibitions will be wiped out completely and he is well on the way to being intoxicated in the ordinary sense of the word Some people in this condition are joyful and friendly, others are surly and belligerent, while others may be deeply depressed and indulge in a "crying jag" It is true that when a person is in this stage of intoxication his fundamental personality is unmasked

The old Roman saying *in vino veritas*, which means "in wine there is truth," has a high degree of accuracy In other words, the real personality of an individual will often be revealed when he is intoxicated After a person has taken more alcohol his impulses likewise become seriously affected, muscular co ordination is decreased he is unsteady on his feet, he drops articles, and his speech is indistinct When more alcohol is consumed he finally becomes drowsy to the point where he finally falls asleep This fact fortunately saves many lives, because if he consumed more alcohol the concentration would finally get up to the point as it sometimes does where the respiratory center in the brain is affected and death results

Detection of Alcoholism —From a practical standpoint, how is alcoholism to be detected by the police officer or investigator? For years the standard practices have been such tests as walking a straight line, touching the finger to the nose, and other exhibitions of muscular co ordination *These tests are highly inaccurate* Reliance on the smell of liquor on the breath is full of pitfalls, due to the fact that cheap wine and beer generally produce a much more offensive breath than liquor of much higher alcoholic content The law has always more or less presumed that nearly anyone can tell when a person is drunk, but such is not the case There are many medical conditions which cause symptoms similar to those of intoxication For instance

the early stages of carbon monoxide poisoning closely resemble those of alcoholism A person with a fractured skull may stagger and mumble his words

In the last few years scientific methods have been developed to the point where the state of intoxication can be determined with a high degree of accuracy When a person drinks alcoholic liquor, it is absorbed from the stomach and intestinal tract into the blood stream where it is carried to the brain, and it is the effect of alcohol on the brain and spinal cord that causes drunkenness The degree of intoxication is in direct proportion to the concentration of alcohol in the brain

If it were possible to take a piece of the brain of a living person and determine how much alcohol was in it, one could tell exactly how intoxicated he was Fortunately, the concentration of alcohol in the brain is approximately the same as that in the blood stream and it is possible to get a specimen of a person's blood without great difficulty From 4 or 5 cubic centimeters of blood removed from the veins in the arm the amount of alcohol in the specimen can be accurately measured and from that the degree of intoxication determined This method is in frequent use today and replaces guess work by scientific calculation

Alcohol is eliminated from the body through the urine, bowels breath, skin and saliva In the last few years methods have been perfected for measuring the degree of alcoholism by tests of the urine, breath and saliva as well as the blood The most important of these is the method devised by Dr Harger of the University of Indiana for determining the degree of intoxication by means of measuring the alcohol in the expired breath This test consists of having the suspect blow into a small rubber balloon This air is then passed through a mixture of potassium permanganate and sulphuric acid which oxidizes any alcohol which may be present It is possible to make an accurate measurement of the percentage of alcohol in the expired air and from that figure the concentration of alcohol in the blood is easily determined This test has the advantage of avoiding the necessity of taking a suspect to a hospital or a doctor's office, and also the advantage of knowing the result of the test at once This apparatus perfected by Dr Harger is known as the *drunkometer* and has much to recommend it Recently Dr Forrester has per

fected an apparatus which operates on the same principle as the drunkometer but is more compact and may readily be carried in a police car Recently several other devices have been perfected which utilize the same general principle as the drunkometer and have their own special fields of usefulness

Tests of alcohol in the urine and in the saliva have a high degree of accuracy, but at present are not as widely used as tests on the blood and breath

It frequently happens that the individual who is investigating a death would like to know if the deceased was intoxicated at the time of his death If an autopsy is performed, specimens of the blood or brain tissue can be obtained and their alcoholic content determined This is so important that *it should be a general rule that at every medicolegal autopsy a specimen of blood be obtained for this purpose* However if an autopsy is not performed, a specimen of blood can be procured at the time of embalming on which an accurate determination of alcoholic percentage can be made Follow the suggestions for obtaining blood on page 263

The chart on page 272 shows the percentage of alcohol in the blood and urine which corresponds to the usual physiological effects In general it may be said that a person who has a concentration of alcohol in his blood stream of 15 of 1 per cent is under the influence of liquor to a degree making it unsafe for him to operate a motor vehicle Tests made at Evanston, Ill showed that drivers with more than 15 of one per cent of alcohol in the blood were 55 times more likely to become involved in a personal injury accident than drivers who had not been drinking Several states have passed laws setting up this standard as determined by scientific methods It will be seen by Figure 114 that when the concentration in the blood stream approaches 5 of 1 per cent, the individual is unconscious and death is imminent

Recently I saw a man who, when intoxicated drank a whole pint of whiskey without stopping He lay down on the floor and in about fifteen minutes was dead The cause of his death was that he took the alcohol so rapidly that before it could be eliminated, the concentration in the brain reached the lethal point.

The ordinary person eliminates alcohol quite rapidly and regardless of the amount consumed none remains in the living body after 24 hours In general this is at a rate of approximately one third to one half an ounce per hour or in terms of whiskey from two thirds of an ounce to one ounce Consequently, it can be seen that if a person drinks slowly but over a considerable period of time, his elimination tends to keep up with his intake Therefore he does not become highly intoxicated, while if large amounts are taken in a short period of time, the concentration may reach dangerous limits

Other factors tend to influeoce the speed with which the concentration is increased A considerahle amount of food in the stomach will greatly slow up the absorption of alcohol into the blood stream Gin seems to be absorbed faster thao whiskey It can thus be seen how hazardous it is to estimate the degree of intoxication from the amount of alcohol consumed The steady, hard drinker will absorb alcohol into the blood stream more slowly than will the occasional drinker Chronic alcobolics may drink large amounts of liquor day after day for years without appearing actually intoxicated, probably due to a slower rate of absorption into the blood and a more rapid elimination However definite character changes delirium or insanity may result from such addiction

Interpretation of Postmortem Alcohol Fiodings—While it is true that approximately one half of 1 per cent of alcohol in the hlood will generally cause death, persons may be found dead with a much lower concentration present Jetter has pointed out that it is not necessary that a person die at tbe height of his brain alcohol concentration for death to have been caused by alcohol poisoning When concentration reacbes a high level in the brain, fatal damage may he sustained by the nervous system but before death takes place some or even all of the alcohol in the body may have been oxidized and excreted Consequently, it is not rare to find moderate or low concentrations of alcohol in the blood or brain of persons whose deaths were undoubtedly due to alcobolism

Following death the concentration of alcobol in the body does not change appreciably for the first 24 or 48 hours But it is very important to bear in mind that after decay and putrefac-

tion have set in, tests for alcohol may be inaccurate due to substances produced by tissue decay Instances are on record where tests on decomposed bodies have given values of more than 50 per cent of alcohol when it was known positively that the deceased had not been drinking prior to death

CHAPTER 15

Deaths Due to Direct Violence

THE INVESTIGATOR is often called upon to examine cases where death has apparently been due to direct violence In such cases there are usually lacerations or bruises upon the surface of the body However, the absence of these marks should not lead one to believe that direct violence or blunt force could not have caused the death Many insurance policies require that where claims are made for accidental death that there must be external signs, such as bruises or lacerations, to indicate that death was accidental It is entirely possible and not infrequent that a person may suffer such a death with no such indications whatever on the surface of the body

Since automobile accidents have become so frequent, the number of deaths from this cause has grown to such proportions that they are one of the major problems that come to the attention of the coroner or medical examiner

Injuries to the Head —The scalp is one of the most frequent sites of injury on the body Since the scalp overlies the hard skull underneath, it may be lacerated by blunt force in such a way that one would think the victim had been struck by a sharp instrument For instance a fall on a smooth surface like ice or a hard floor may result in a clean straight laceration This fact has been misinterpreted in many important cases

The skull in an adult is a solid bony structure and injuries to it do not cause death unless the brain underneath has been damaged The mere fact that the skull may not be fractured does not indicate that there may not be serious brain damage, on the other hand a fracture of the skull may occur, yet the damage to the brain be comparatively slight The brain in a living person has a semi solid consistency It is difficult to handle the brain without its falling apart because of its weight The spinal cord which extends down inside of the spinal column is of the

FIG 115 Death due to head injury Notice the bleeding *from the ear* which always indicates the possibility of a fracture of the base of the skull

same consistency and is actually a brain stem Consequently, it *often happens that when a person falls, striking his head on a* hard surface, the brain tends to be compressed on the side of the injury, and is torn away from the opposite side so that the bulk of the brain damage may occur on the side opposite to that *which received the blow* **This phenomenon is known** *to medical* men as ***contrecoup*** When a person is struck a blow on the head by an instrument such as a hammer, billy, or club with such violence as to cause injury to the brain, that injury is usually

located directly beneath the point of impact. *The distinction between these two types of brain injury is of major importance* and the autopsy surgeon should always try to determine whether the damage was due to *contrecoup* or direct impact.

As a general rule injuries to the brain in the back part of the head are more likely to cause death than injuries to the brain in the forward part of the skull. It is not uncommon to see severe injuries to the front part of the head with a massive fracture of the skull and actual oozing out of the brain substance, without the person even losing consciousness. Similar injuries to the back part of the head are usually rapidly fatal.

Another situation that is not infrequent occurs when a person

Fig. 116: The base of the skull of the victim shown in Figure 115. The skull cap and the brain have been removed. Note the long fracture line extending from ear to ear across the base of the skull. (Figures 115 and 116: Courtesy of G. Russell Carrier.)

suffers what appears to be a slight wound of the head He may be stunned for a few moments, but soon feels much better A few hours later he loses consciousness and may die before medical aid can be summoned In these cases there has usually been a rupture of one of the arteries supplying the membranes that cover the brain called the *meninges* A slow oozing takes place

Fig 117 Death due to a blow on the head with an iron bar Extensive scalp laceration with fracture of the skull The victim was taken for a ride and while riding in the front seat was struck from the rear (Courtesy of G Russell Carner)

FIG. 118: Murder and robbery. The victim was struck over the head by one of the timbers shown in the photograph. Note the pockets turned inside out.

until a large clot is formed, and the pressure from this eventually causes death. For this reason it is well to keep a person in bed under close observation for a period of at least twelve hours following even a minor head injury.

A severe blow on the chin may result in a fracture of the skull with severe brain injury. The force of the blow is transmitted to the point where the jaw hinges on the skull, often causing death. This occasionally happens in boxing matches. Repeated blows on the head over a long period of time may cause the formation of small areas of scar tissue throughout the brain substance, giving rise to unsteadiness of gait and a mumbling speech. The victim is commonly known as *"punch drunk."* *Concussion* of the brain is a term indicating a severe shaking up of the brain substance, without causing major lacerations or

bleeding The victim may be unconscious for a considerable period of time but generally recovers completely

Subdural Hematoma —After severe head injury sometimes a large clot forms over the surface of the brain but underneath the tough membrane which encloses the brain substance Usu

Fig 119 The face of the victim shown in Figure 118 (Figures 118 and 119 Courtesy of G Russell Carrier)

ally it is located on the side of the brain in front of and slightly *above the ear Particularly in elderly people this condition may* result from comparatively minor violence and sometimes there is no history of any head injury whatever

The clot becomes encapsulated after a few days but tends to gradually expand with increasing pressure and displacement of the brain If the condition is recognized it may be removed surgically with complete recovery to the patient

FIG 120 Death after an apparently minor blow over the left eye (See Figure 121)

FIG 121 The brain of the victim shown in Figure 120 The dark area is from bleeding caused by the blow (Figures 120 and 121 Courtesy of G. Russell Carner)

FIG 122 Wounds caused by bludgeoning by a leather bag filled with shot (*Courtesy of Dr Frank Dutra*)

The condition may go unrecognized for weeks while the victim undergoes gradual deterioration becoming lethargic and stuporous uncoordinated vision disturbed and complaining of headaches In about half the cases the pupil of one eye is markedly dilated and most frequently it is on the same side as the subdural hematoma *The condition may progress over a period of* weeks or even months before death follows

Subdural hematoma is of medicolegal importance due to the fact that persons suffering from this condition may become embroiled in arguments or fights during which they collapse with death following shortly The antagonist may be accused of inflicting injuries which caused the death and in such cases it is vital that a complete autopsy be performed and particularly important that a detailed history of the victims health prior to the

Fig 123 Wounds believed to be caused by ramming the head with the end of an iron pipe There were similar wounds on the other side of the head Autopsy revealed numerous skull fractures and extensive brain damage

alleged assault be obtained Sometimes it can be demonstrated that the victim was already suffering from a subdural hematoma and that the scuffle or fight had no causal connection with the condition which resulted in death

Injuries to the Neck—The general belief that a broken neck is in itself a cause of death is erroneous A broken neck is no more the cause of death than a fractured skull *Death results only if there has been sufficient damage to the spinal cord* which runs down through the vertebrae There is nothing more hazardous than diagnosing a broken neck as the cause of death without a careful and complete autopsy Even x rays taken after death may be misleading Sometimes the vertebrae themselves will not be broken but are dislocated to the extent that the cord may be severed *The vertebrae may then slip back into their* natural position, giving their normal appearance upon x ray

Likewise one cannot diagnose a broken neck by twisting the head after death The only way in which an injury of this nature can be determined as the cause of death is by dissecting the structures of the neck until the bodies of the vertebrae can be actually seen and felt Many times attempts are made to make a diagnosis by an incision on the back of the neck, but this is usually very inaccurate unless a deep dissection is made and the fracture brought into view

Wounds of the Chest—Crushing wounds of the chest may kill a person by fracturing several ribs the broken ends of which tear into the lung substance and cause bleeding within the lung

The pleural cavity which lies between the lung and chest wall may also be filled with blood or air, causing the lungs to be displaced and collapsed The heart lies close to the front of the chest just underneath the breast bone A person may receive a severe blow in this region, causing sufficient damage to the heart to result in death In automobile collisions the driver will frequently be thrown forward against the steering wheel compressing the heart between the front wall of the chest and the back bone Such injuries may be rapidly fatal

Wounds of the Abdomen—The abdominal cavity contains many organs and the rupture of any of these may cause internal bleeding and death ***The liver,*** which is large and lies in the

FIG 124 Death caused by skull fracture and extra dural hemorrhage Notice that all the bleeding is between the skull and the dura which is the membrane covering the brain Victims of this type of bleeding may show little or no symptoms for several hours until the blood accumulates to such an extent that it presses against the brain and causes death quickly (*Courtesy of Dr Charles E Black*)

upper right side of the abdomen is particularly susceptible to injury from direct force Rupture of the liver may cause death and yet no mark of external violence be apparent on the skin

The spleen which lies towards the back of the abdomen on the left side is likewise often fractured This organ is covered with a thin capsule something like a sausage Sometimes the spleen itself will be fractured while the capsule will remain in tact A victim may apparently recover from his injury and

several days later the capsule give way, causing extensive internal bleeding, death takes place rapidly

The intestines likewise may be ruptured by direct violence to the abdomen Rupture of the intestines has also been caused in industrial plants where an employee indulges in horse play by pointing a high pressure air hose at another worker's rectum If *the bladder* happens to be distended with urine, it is susceptible to fracture by direct violence to the abdomen If empty, it is not so likely to be damaged

Injuries to the Bones —If a person has received a severe crushing injury to one of the large bones such as the thigh bone particles of fat in the bone marrow may be taken up by the veins and carried to the heart and lungs The amount of fat in the blood stream may be large enough to cause death This condition is known as *fatty embolism*

DEATHS DUE TO ELECTRICITY

Deaths due to electricity are classed into two general categories 1) those due to high tension currents and 2) those due to comparatively low voltages When a high voltage current passes through the body, the muscles, including the heart, are thrown into a state of spasm and death results very shortly In addition to this, the resistance to the body may cause a large amount of heat to be produced so that the increase in temperature may also play a part in causing death The portion of the body through which the current passes is also important For instance, a high powered current of electricity may pass through some portion of the body, such as the arm or leg and only that portion of the body will be seriously injured, however if it should pass through the trunk or head death would result almost instantly Contrary to popular opinion, the dangers of alternating current and direct current are equally great

In cases of death due to legal electrocution, the resistance set up by the body causes a tremendous amount of heat and the portions of the body adjacent to the electrodes may be actually burned The greatest apparent damage appears at points where the current enters or leaves the body Often severe burning of the skin in those areas is evident

Persons are often *electrocuted from ordinary 100 to 110 volt* house current These electrocutions are most apt to occur if the body is well grounded, as when a person is standing in a bath tub full of water or on a wet basement floor In these cases, death does not usually occur instantly, and if the condition is recognized in time, the life may be saved by artificial respiration When this happens the heart is usually affected, there is a change in the strength and rhythm of the heart beat known as *auricular fibrillation* This condition of the heart causes a failure

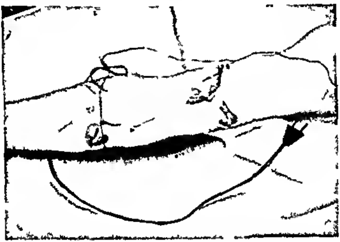


Fig 125 Suicide by electrocution The victim wrapped the wire around his arm, was well grounded and then inserted the plug Ordinary house current (110 volts A C) caused death (Courtesy of C W Muehlberger)

of blood supply to the brain with loss of consciousness The fibrillation may continue for some time and then the heart stops beating, resulting in death However, in many cases artificial respiration will serve to keep the person alive and the heart beat will return to normal

If a person has been *killed by a strong current of electricity*, at the point where the current entered the body, very fine particles of the metallic conductor may be embedded in the skin These cannot be seen but a trained laboratory technician can demonstrate their presence by chemical tests This fact is of importance in differentiating deaths due to electrocution from obscure causes

DEATHS DUE TO LIGHTNING

Lightning differs from usual electrical deaths in that the victim is in the path of a current of enormous voltage for only an instant Consequently, he may be injured or killed by either the electrical current or the expanded and repelled air The latter cause accounts for the tearing of clothes and shoes off of the

FIG 126 Death by electrocution The victim was attempting to make a temporary hook up with a 3 way plug in a 220 volt circuit of electricity The current entered the right hand and emerged from the left index finger which was grounded Notice the burns on the right hand and the bursting type of wound on the left index finger (Courtesy of Dr Herbert P Lyle Cincinnati)

FIG. 127: Tissue destruction by dynamite It is estimated that about ten sticks of 40 per cent dynamite caused this damage from a distance of only a few inches

victim. Occasionally the body is hurled for some distance Injuries produced by the latter cause alone are often sufficient to cause death.

Three types of electrical burns may be produced

1. *Linear burns.* These are usually narrow stripes, a foot or more long The victim appears to have been struck by a switch. These streaks commonly follow the folds of the skin which contain increased amounts of perspiration
2. *Arborescent burns* have been commonly known for years as *Lichtenberg's flowers.* They are generally located in the upper surface of the body and greatly resemble the stems and leaves of plants Since ancient times, these markings have been believed to be images of the surrounding vegetation but this is not true. If a person survives the stroke they disappear within a day or so
3. *Surface burns* occur beneath metallic objects which are worn or carried by the victim. These are true burns which are caused by the terrific heat generated by the current In general persons who have suffered severe burns do not survive

Individuals struck by lightning are usually rendered unconscious immediately and characteristically urine and semen are ejected *Immediate artificial respiration may save the lives of a large percentage of lightning victims.* On return of consciousness there is a wide variety of symptoms affecting principally the nervous system. Among them are visual disturbances, severe headache, loss of use of the arms or legs and sensory loss over

various parts of the body If the person survives, these symptoms abate in a few hours and recovery is generally complete One may have no recollection of anything that happened Further disturbances of the nervous system are not apt to occur at a later time

Autopsy Findings —The skin is very blue, and the chief findings are hemorrhages in the pancreas and in the respiratory tract Usually these areas of bleeding are numerous and vary in amount from a slight indication of hemorrhage to sizable quantities of free blood

DEATHS DUE TO EXPLOSIVES

When a person is in the immediate vicinity of an explosion death may result from a variety of causes depending upon the nearness to the explosion and the nature of the explosive material

In the case of illumination gas explosions the velocity of the shock wave is comparatively low so that while the destruction to a building may be great, the principal injuries which a person receives are usually from falling debris or injuries caused by being hurled against some solid structure In this type of explosion the injured person may also receive severe burns I once saw two men who had been standing in the center of a large warehouse used for ripening bananas The gas heater had gone out and they were unaware that the entire warehouse was filled with gas When these men attempted to light the heater a violent explosion occurred hurling the concrete walls a considerable distance Except for some burns on their faces and hands they received no damage due to the fact that they were in the center of the explosive force, whereas had they been standing along the walls it is likely that they would have been killed When a person is exposed to a nearby explosion of dynamite, nitroglycerine or a similar substance the shock wave has many times the velocity of that encountered in gas explosions

During the bombing of European cities many persons were killed by rupture of the air cells in the lungs and internal hemmorrhage due to the shock wave If a person is very close to the explosion of these substances there may be an actual blasting away of portions of his body I know of no scientific work which

has been done to determine just how far a person must be from an explosion to lose body tissue but the most reliable opinion is that for this to happen a person must be within the range of the actual flash of the blast This does not take into consideration serious injury which may be caused by flying pieces of debris

Many persons are of the opinion that a high explosive exerts its principal force in a downward direction but this is not true The explosion exerts its shattering effect equally in all directions The destructive force of the blast diminishes in proportion to the square of the distance from it

MEDICAL NOTES ON DEATHS OF INFANTS AND NEW BORN

The doctor or pathologist is confronted with some special problems in examining the dead bodies of infants or new born One of the most common is the question *has the baby ever breathed?* The answer to this question is extremely difficult to determine

For many years a great deal of reliance has been placed upon the *hydrostatic lung test* This was performed by taking a small section of lung tissue and placing it in a pan of water Floating was regarded as evidence that the child had breathed and sinking was accepted as evidence that the child had never taken air into the lungs *It is dangerous to place any faith whatever in this test* A baby may breathe well for several hours and then breathe poorly and die with lungs which will sink On the other hand air may be forced into the lungs by mouth to mouth breathing or artificial respiration and cause lung tissue to float although the baby never took a breath

It takes about three days for the lungs of a normal new born to be completely expanded and much longer than that for a premature new born

There are two principal causes of atalectasis (collapse of the lungs) of the new born

1 Brain injury characterized by edema (water logging) or hemorrhage or both
2 Inspiration of amniotic fluid or vernix

Resorption atalectasis may take place after normal expansion

of the lungs and is rather good evidence that the baby has breathed

Prematurity alone is not a sufficient cause of death as an infant may live unless the case is badly managed or there is some congenital defect incompatible with life Hemorrhage is characteristic of deaths of premature infants

How Long Did the Infant Live —This question may be difficult to determine accurately but the doctor can be guided to a certain extent by the amount of expansion of the lungs and also the amount of meconium (fetal bowel contents) remaining in the large intestine However he should bear in mind that while the bulk of the meconium is evacuated in the first two or three days, *some of it may still be present for as long as eight or nine days* Another indication may be the condition of the stump of the umbilical cord Normally it drops off in about a week In the examination of the blood do not be misled by the number of nucleated red cells *which may be found normally for several weeks after birth* If the infant has died an asphyxial death the number of nucleated red cells may be increased

CHAPTER 16

The Investigation of Deaths Due to Highway Accidents

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As in all criminal investigation, it is extremely important that the investigator of a highway accident make his observations and collect his evidence as soon as possible after the accident has occurred. A complete account of the occurrence together with photographs, accurate measurements, and a sketch of the area involved should be made at once Obviously, certain types of evidence are easily lost or defaced as heavy traffic moves over the highway. Skid marks, tire imprints in mud, bits of glass or broken parts of an automobile and similar types of evidence are easily obliterated or destroyed on a busy highway within a short period after the occurrence of the accident.

INVESTIGATION OF THE SCENE OF THE ACCIDENT

The investigation of the scene of the accident consists of a search for traces left by the vehicle (automobile, airplane, truck, motorcycle, bicycle, tractor or horse-drawn vehicle) and traces left by the victim of the accident who may have been struck by the vehicle or thrown from it.

Traces Left by Vehicle.—

1. *Skid Marks.*—The location, direction and length of skid marks may be very important to a reconstruction of the facts of an accident and to the evaluation of the statements made by

the driver of the vehicle or other witnesses They serve to check on the driver's statement as to how soon he saw the pedestrian or obstacle and how rapidly he applied his brakes They also give a fairly reliable guide as to the speed of his vehicle at the time the brakes were applied (see *Journal of Criminal Law and Criminology*, volume 30, page 96, 1939–1940) Skid marks should not only be measured accurately and designated on the sketch of the accident scene, but their shape and location should be recorded by the taking of appropriate photographs

2 *Dirt from the Under surface of the Fenders* —The location of such dirt dropped on the highway as a result of the impact of an automobile with some resisting medium may be of great value in the reconstruction of the accident Coupled with the observation of the skid marks, it may provide valuable evidence as to which of two vehicles was violating the rules of safe driving established for the community The location of such dirt should appear in the photographic record of the acciden t scene

3 *Tire Tracks left in Mud, Sand, or Snow May Give Valua ble Evidence as to the Identity of the Automobile or Airplane* — *This is particularly true if the imprint of* the tire is *so fresh as to* show details of surface defects in the tread While all tires of the same size and manufacture are pretty much alike as they come *from the moulds they take on highly individual characteristics* after they have been driven for any distance Skid marks, cuts by glass nails and sharp stones and similar abrasions on the tread surface, cause each tire to assume a distinctly individual character These cuts and worn areas in the tread of the tire which are then imparted to the mud, snow or sand in the form of a tire track may enable one to identify the tire positively Record of such tire tracks should be made not only photo graphically, but also with a three dimensional record in the form of a moulage or cast The photograph and moulage *must be made quickly to prevent deterioration of the track due to dry* ing melting or physical defacement

4 *Material from the Vehicle* —This may consist of glass from broken vehicle lights or from a broken windshield or win dow, metal parts from the grille door handles, ornaments or trimmings of the car, or it may consist of fragments of paint or enamel knocked from the car by impact Likewise, the pres

Fig 128 Car traced by parking light A young man walking along a high way late at night was struck by a car and killed At the scene of the accident a broken parking light was found The light was identified by the manufacturer as belonging to the model shown above A check on the registration of this particular model in the area resulted in the finding of this car

ence of puddles of oil, water or antifreeze may give evidence of damage to the automobile if the vehicle itself had been driven away or removed prior to the discovery of the accident If a suspect s car is discovered later the matching of such particles of glass into the remaining portion of the light lens may be of value in showing that the light was broken at the site of the accident Where the particles of glass are too small to permit a matching of fracture surfaces, it still may be possible to show similarity of their physical properties to those of the glass of the suspected car Thus *even with particles of glass as small as sand grains,* one may determine such properties as specific gravity, refractive index and optical dispersion Where these values are identical for both the glass particles found at the

Fig. 129. Headlight of the car shown in Figure 128. The original lamp was completely broken out and an attempt had been made to fasten in a new one with electrician's tape.

scene of the accident and the glass remaining in the suspect's automobile, this is a valuable circumstance which may be of help in convincing a jury. Likewise, portions of the broken grille trim or door handle of the car found at the scene of the accident may be matched with the portion remaining on the car.

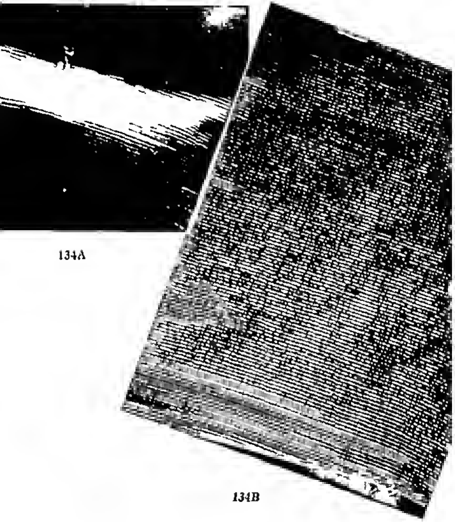
Traces Left by Victim.—Careful search of the scene of the accident should be made for traces of blood, body tissue or human hairs which may have resulted from the injury to the victim by the impact of the vehicle. Likewise, if the clothing of the victim had been torn by the impact, one may find cloth or textile fragments at the scene of the accident. The location of such evidence should be noted carefully on the sketch of the accident scene and the material retained for examination. If the blood is fresh and moist, a small amount of it should be taken to the laboratory at once for examination. Hairs, textile frag-

FIG 130 An example of the importance of examining the under surface of a suspected car Here is the victim's jacket wrapped around the drive shaft (Courtesy of G Russell Carner)

ments and suspected human tissue should be carefully wrapped in clean paper, placed in envelopes and taken to the laboratory as quickly as possible

EXAMINATION OF THE SUSPECTED VEHICLE

The vehicle suspected of having been involved in the accident should be examined for evidences of impact, also for any traces left on it by contact with the victim's person or with any vehicle in which the victim may have been riding Such an examination should not be made casually Strict attention should be paid, not only to those portions of the car which might have struck the victim, but *especially to the undersurface of the chassis* For this latter purpose, the use of a greasing rack or a hydraulic hoist, such as is commonly employed in



134A

134B

Fig 134 Fig 134A is a photograph of a mark on the right front fender of an automobile which struck and killed a young boy Notice the small ridges rubbed into the paint by the weave of the boy s clothing

Fig 134B is a photograph of the material in the corduroy trousers the boy was wearing A comparison of the two sets of ridges forms strong corroborative evidence that the car in question struck this boy

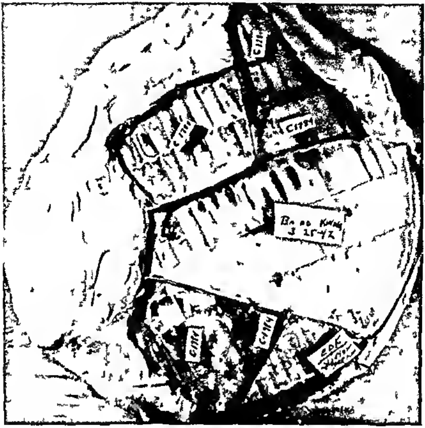


FIG 135 The fitting together of pieces of a head light lens on putty Following a hit and run accident the pieces marked C 1784 were found in the street at the scene The police notified all garages that a head light lens had been broken The owner drove his car to a garage and helped the mechanic remove the pieces marked *BAIRD KINDER* and *EDK* The pieces were tossed into a waste basket but were later picked out by the mechanic who notified the police of the make of the car and license number

These relations can best be demonstrated by careful photographing of the scrape marks and of the fabric, taking care that both the photographs are enlarged to the same degree of magnification (Fig 134 A & B)

Evidences of ***broken glass*** in the suspected vehicle should be searched for and any remaining glass from a broken head light bulb, spotlight, parking light or wind shield, should be preserved and compared with the broken glass found at the scene of the accident In this way it is frequently possible to

Fig 136 Broken radiator ornament A man was struck by a car and .. by a hit and run driver Buried in the back of the victim was found the radiator ornament which in the picture is held by the fingers of the police officer *Some weeks later a suspected car was located and here the orna* ment is being fitted to the place where it was broken off

piece together glass from the scene of the accident and glass remaining in an automobile headlight so as to show beyond all shadow of a doubt that the glass of the accident came from that particular headlight (Fig 135)

Broken off *metal parts* also should be carefully observed and a comparison made of any particles of broken metal found at the scene of the accident to see if these match the missing parts on the suspected vehicle In one instance, a car which was re sponsible for a fatal ' hit and run ' accident was positively iden tified by means of its radiator emblem which was previously found buried in the back of the victim A matching of the fracture of the portion of the emblem taken from the body with that re maining at the front of the hood of the suspected automobile showed definitely that they had once been a single piece of metal (Fig 136)

Occasionally, areas of chipped-off paint or enamel may be found on the suspect's vehicle. *Any paint or enamel* found at the scene of the accident should be retained and compared with that of the suspected vehicle, not only as to color and composition, but also as to the shape of the chipped-off enamel particles with respect to the corresponding areas of the suspected vehicle from which paint or enamel had apparently recently disappeared. These points may all be well established by taking appropriate photographs

Traces Left on Automobile by the Victim's Person.—From the nature of the injuries to the victim, one may best judge as to the type of material which may be expected Thus, in an injury where there has been no shedding of blood, it seems futile to search for blood stains. Or in an instance where the body surfaces have not been materially injured, it is a waste of time to search for particles of tissue or bone. Conversely, where there has been profuse bleeding or where the skull has been fractured and brain tissue knocked from the cerebral cavity, one may well expect to find blood stains, particles of bone or of brain tissue on parts of the automobile which may have come into contact with the victim's body. As has been previously pointed out, a thorough search of the under-surface of the car should be made for evidences of contact with the body as the car passed over it

Blood Stains.—If blood stains are found, their location and *size should be carefully noted*, *the direction of splashing may be* determined from the shape of the stains Inasmuch as many wild animals (squirrels, dogs, cats, etc) are encountered in night driving on the highways, one may occasionally find the blood of these on any automobile. Such splashes from contact with animals are ordinarily found on the bumper or grillework of the car; blood stains found at higher points from the ground are more to be suspected Observations should be made as to whether the blood stains appear to be fresh (moist and sticky) or whether they appear to be well dried. In either event, the laboratory technician should be asked to examine them in order to get the maximum information from the stain. The examination will establish:

(a) That the stain ***is actually blood*** (it may very well be red paint or some other foreign substance which has a red color).

Fig 137 The victim of a hit and run accident On alighting from a street car, this woman was side swiped by an automobile

Fig 138 The same body showing a deep gouge in the back

Fig 139 Another view, showing an injury to the right forehead and arm

FIG 140 The suspected vehicle Note how the mud is brushed off the lower part of the front fender (*see* arrow), the broken door glass, the missing door handle and the mark across the lower half of the door where something has rubbed over it

FIG 141 Another view of the car showing the wide mark across the doors (lower half) and the deep black area on the rear fender near the door where the grime has been brushed off At the point indicated by the arrow, the investigator saw an area where he thought hair was sticking to the paint

FIG 142 A close up photograph of the spot indicated by the arrow in Figure 141 *Note the scuffing mark with hair sticking to the paint* This proved to be human hair and resembled that of the victim In reconstructing the accident the victim was first struck on the leg by the front fender Her head first struck the glass wind deflector and later the window frame at the point indicated by the arrow The door handle caused the deep gouge in her back and broke off The body brushed along the doors of the car, finally striking the rear fender and wiping off the road grime (Figures 137 to 142 inclusive Courtesy of G Russell Carner)

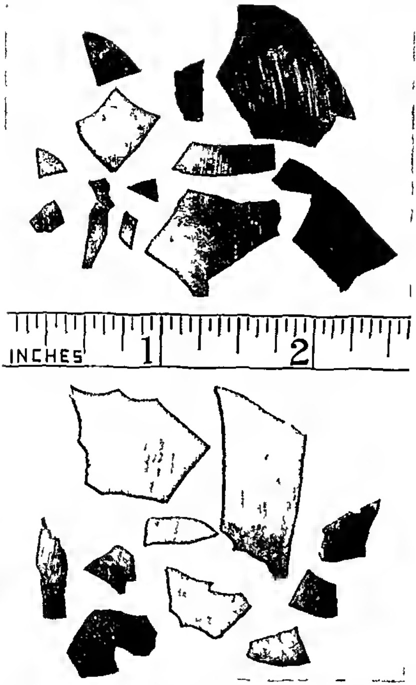


Fig 143 Shortly after dusk, an elderly man walking along the left shoulder of a highway was struck from behind by an automobile and died from resulting head injuries without regaining consciousness The car did not stop after the accident and no witnesses could be found At the site of the impact the only evidence was a number of flakes of blue green automobile enamel These were collected by the son of the deceased and by the county sheriff The under surface of the flakes was slate grey (priming coat) and showed many ridged striations which were most apparent when photographed with oblique lighting

FIG 144 *Investigation by the sheriff resulted in d scovery of a blue green* two-door sedan of ancient vintage vhich had a large fresh dent n the cro vn of the left front fender The owner of the automobile gave a vague and unsatisfactory account of the fender damage He as placed under arrest and the fender removed for laboratory study

(b) That the blood is of ***human origin*** This is important in determining the possible truth of the statement that blood stains resulted from contact with a wild animal

(c) ***The blood group*** of the individual from whom the stain came This can be determined if the stain is reasonably fresh and contains a sufficient quantity of blood Or dinarily a good sized drop of blood is required for grouping tests alone In old dried stains the agglutinins upon which blood grouping tests depend are largely destroyed by aging and oxidation With such old dried stains, an accurate grouping test cannot be made It should be borne in mind that a mere showing that the suspected vehicle contains human blood of the same blood group as the victim is no proof that the vehicle struck the victim Such blood may have come from any other person having the same blood group The converse, however, is of definite probative value The finding of a group 'A blood on a vehicle proves

FIG. 14[illegible] A close up photograph of the fresh metal surface from which enamel had recently been broken showed many grooves or scratches such as are produced by abrasives It appears that this fender had been previously damaged bumped out ground down with a sanding wheel and re enameled

definitely that this could not have resulted from the striking of a victim having group B blood Thus it may be seen that blood grouping tests provide very little help to the prosecution in a "hit and run" case although they may prove of the utmost value in the defense of such a case

Tissue Particles—Particles of tissue or bone which may be found on the automobile should be carefully preserved and taken at once to the laboratory for examination Such particles are frequently found on the front of the car where the victim was struck or on the sides of the car (at hinges or door handles) where the victim's body was thrown from the car, or on the under surface of the car such as on the axle, springs or differential where the car may have struck the body as it passed over it

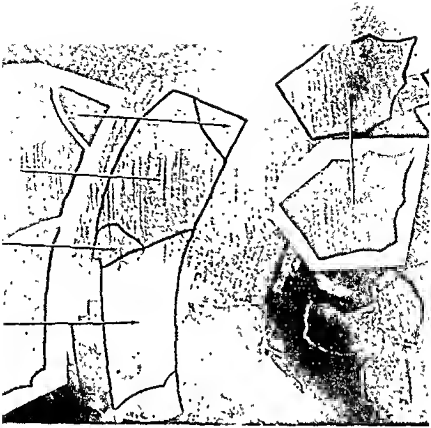


FIG. 146: Identical markings on enamel flakes from the scene of the accident and of abrasive scratches on the surface of the fender shows that the enamel flakes came from the damaged area on the fender. (Note Photographs of enamel flakes are *reversed* so as to permit direct comparison, otherwise they would bear an enantiomorphic relationship to the fender scratches)

If the amount of tissue is sufficient, it may be possible to establish its nature by a histological examination (an examination by which the material is cut into very fine slices, stained with dyes and examined with a high power microscope).

Hairs.—Since the head of the victim is frequently brought into violent contact with the automobile which strikes him, it is not at all uncommon to find his hair on the suspected vehicle. The hair may be merely adhering to the car or it may be embedded in blood, tissue or grease. In any event, the hairs should be removed after their location on the car has been definitely noted and such hairs submitted to the laboratory for a microscopical examination in comparison with hairs known to have come from the body (usually head) of the victim. From an examination

of hairs taken from the car and hairs taken from the victim, one may draw certain conclusions The two groups of hairs (from the vehicle and from the victim) should be compared as to their

(a) *Color*
(b) Waviness
(c) Range of diameter
(d) Degree of ellipticity of cross section Straight wiry hairs, such as those of the American Indian or Chinese, are more likely to have a circular cross section than very wavy or kinky hair such as the head hairs of Negroes The latter are more likely to be elliptical in cross section
(e) The size and distribution of the pigment granules in the shaft of the hair
(f) The presence or absence of a "*medulla*" or "core" in the center of the hair shaft, also whether this medulla is continuous, discontinuous, spotty, or entirely absent In human hairs, the medulla only occupies 1/4 to 1/5 of the total diameter of the hair In other animals, the medulla constitutes a large proportion of the hair diameter
(g) The ends of the hair from the victim will indicate *whether or not it has been forcibly* removed *from the* scalp (as evidenced by finding a portion of the hair root still adhering to the root end) or whether the hair had been cut as evidenced by an examination of the tip end Hairs which have not been cut at all, taper to a very fine point Hair which has been recently cut shows angular edges at the cut end A hair which has been cut some weeks previously, shows these edges to be quite rounded from frequent brushing and combing
(h) Examination for the presence of dyeing or bleaching is made largely by microscopic and micro chemical methods *The absence of pigment granules in the shaft of the* hair as compared to their presence close to the root of the hair, suggests that the hair has been bleached Likewise, the diffuse penetration of dye into the hair can be noted by microscopic examination in compari-

son with the natural color which occurs in definitely-shaped pigment granules within the hair shaft

(i) Examination of the surface of the hairs will establish definitely whether or not they are of human origin The cuticular scales on the outside of any hair overlap to a varying extent similar to the overlapping of shingles on a roof In animal hairs, the overlapping is not as great as it is in human hairs

In securing specimens of hair from the victim, one should be careful to *take specimens from the various areas which have been struck.* Thus, if the victim has been violently hit on the side of the head over the right ear, one should collect at least some specimens from that area of his head for comparison with hairs which might be found on the suspect's automobile Even with the most thorough examination of hairs from the suspect's automobile and a very satisfactory comparison of these with the hairs from the victim, the most an expert can state on the witness stand is that the hairs from the automobile *might* have come from the victim It is never possible to state that the hairs on the automobile *must* have come from the victim and could not have come from any other human being Thus, hair evidence, while valuable from the circumstantial point of view, does not have the highest probative value

Textile Fragments or Fibers—Textile fragments or fibers from the clothing of the deceased may be of greater value than hairs This is particularly true where a piece of clothing has been torn from the victim and remains attached to the running gear of the suspect's automobile In such an event, it may be possible to show the corresponding size and shape of the fragment of cloth and the hole in the victim's clothing from which this fragment was torn (Fig 147) Even when it is impossible to show that a piece of cloth has been torn from the victim's clothing, the finding of threads or fibers of material similar to those of his clothing may be of considerable value Thus, the finding of blue and white cotton fibers or threads on the running gear of a car may be of value when the victim was wearing a pair of overalls which were torn in the accident Examination of fibers from the car should establish their nature (whether cotton, wool,

rayon silk etc) and also a comparison of the color of the dye which was present These should be compared with threads from the clothing of the victim preferably using a comparison micro scope

Traces Left by the Victim s Vehicle —The suspect s auto mobile should he carefully examined for traces which may have been made by contact with the victim s vehicle These may con sist of pa nt rubbed off at the point of impact or scrape marks which may be traced to a definite area of the victim s vehicle

EXAMINATION OF THE VICTIM

The body of the victim should be examined first for evidences left by the striking vehicle upon the victim s clothing and his body Finally in any fatal case it is absolutely essential in any criminal prosecution to establish the cause of death and to rule out all other possible causes Therefore a complete postmortem examination should be conducted by a competent medicolegal pathologist

(a) To determine the exact nature of the injury received by the victim and which injuries resulted in his death
(b) To determine the degree of incapacity of the victim through disease or poisoning so as to account for his alleged negligent behavior

Clothing —An automobile striking a victim occasionally may leave traces of enamel or paint upon that portion of the victim s clothing which comes into violent contact with the car An examination of this paint or enamel may be of value when it is compared with the paint or enamel of the suspected automobile This is particularly important where the suspected automobile contains material which has been rubbed off in an area which would be expected to have struck the victim Such evidence is especially striking where the color of the enamel of the suspected automobile is quite different from the color of the victim s clothing If the amount of enamel on the clothing is of sufficient quantity it may be poss ble to establish its composition by a laboratory analysis Traces of automobile enamel which are too small to analyze by ordinary laboratory methods may be sub jected to spectrographic analysis Such an examination will not

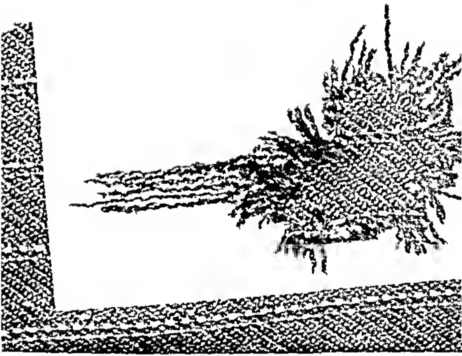


FIG 147 A boy was struck and killed by a hit and run driver The investigating officer noticed that a small piece of cloth had been torn out of his right sleeve, as shown on the upper part of the picture Several days later an automobile was located which was suspected of being the car which struck the boy Wedged under one of the pieces of chromium on the *front fender was found the piece of cloth shown in the* lower part *of the* picture. It can be seen here that it matches perfectly with the hole torn in the sleeve of the coat, which proves beyond any question that it was the car which killed the boy

only permit the identification of the various elements of the pigment contained in the enamel, but may furnish some clue as to the manufacturer of the automobile Likewise, tears in the victim s clothing may be traced to bits of fabric or threads found adhering to the suspect's automobile

Injuries —Traces made by the striking vehicle coming into contact with the victim s body may be of considerable value in establishing the identity of the suspect's car Thus, where a person has been struck with a certain portion of the car, the shape of the contusion may be such as to show the outline of the corresponding portion of the automobile Such comparisons may best be made by a careful photograph of the injuries to the surface of the victim's body and a comparison of such photographs with a photograph of the car made to the same degree of magnification The exact nature of injuries must be established, and the pathologist should be able to establish whether or not such injuries could have resulted from contact with the suspect s automobile Inasmuch as the defense in such a criminal case is frequently based on the alleged contributory negligence of the victim, it may be very important to establish whether or not the victim was under the influence of alcohol at the time of the accident, also whether or not he was suffering from any other incapacity which would tend to account for his alleged negligent behavior A careful postmortem examination with subsequent chemical analysis of the tissues of the deceased will definitely preclude arguments based on an alleged drunken condition of the deceased or his baving been under the influence of some other toxic agent such as carbon monoxide, hypnotic drugs knock out drops, etc

If the driver of the vehicle which caused the accident is apprehended shortly after the accident, he, too, should be examined as to his sobriety He should be carefully questioned concerning the facts of the accident and also as to his movements during the periods preceding and following the accident and his drinking of intoxicating beverages Where his statements do not appear to agree with his apparent state of intoxication, he should be requested to submit to a blood alcohol test (See Chapter 14)

Chapter 17

Deaths Due to Criminal Abortion

To obtain a conviction for homicide due to criminal abortion is one of the most difficult tasks confronting the medicolegal investigator The reasons for this are many Generally, there are only two witnesses to the unlawful operation one of whom is dead If the relatives of the deceased have knowledge of the circumstances of the death, they are usually reluctant to assist or proceed with the prosecution due to the fact that they object to the publicity involved This brings about a situation which makes a dying declaration almost essential to a successful prosecution The elements involved in a dying declaration and the requirements for taking it are enumerated in Chapter 1

Contrary to general belief, the majority of women seeking abortions are married women and most of them already have several children Probably not more than twenty five per cent are unmarried

Terminating pregnancy *for the purpose of saving the life, health* or *reason* of the pregnant woman is recognized as a lawful procedure and is done frequently by the medical profession Under such conditions the pregnant woman is admitted to a regular hospital and the operation is scheduled the same as any other surgical case However, most hospitals require that a doctor scheduling such an operation have consultation with other doctors attesting to the necessity for the procedure Even in a well equipped hospital under conditions of surgical cleanliness, this operation carries a certain amount of risk for the life of the patient, under the conditions in which the usual criminal abortion is performed the risk is enormously increased To terminate pregnancy merely for the purpose of destroying fetal life

in either a married or unmarried woman is recognized as a crime by both the law and the medical profession No reputable doctor will indulge in such practice However, there are always individuals, both in and out of the profession of medicine, who will perform abortions for the money involved It is only a question of time before they will cause a serious infection or death and an investigation is required

METHODS OF PERFORMING ABORTIONS

Physiology Involved—Pregnancy takes place when the sperm from the male breaks through the cell wall of the ovum and fertilizes it A sperm is exceedingly small, much smaller than a red blood cell, and has a tail somewhat like a tadpole that propels it so that it swims along on even the thinnest film of moisture The ordinary man produces probably more than one million sperms a day, so that at intercourse the number ejected into the vagina is tremendous any one of these may be capable of producing pregnancy The ovaries in a woman normally produce only one ovum or egg a month which matures at a time about midway between her menstrual periods This ovum leaves the ovary and is drawn into one end of the Fallopian tube where it slowly passes down and enters the cavity of the uterus and is expelled

For a pregnancy to take place, the sperm, after being ejected into the vagina must propel itself into the mouth of the uterus, up along the wall of the uterus out through the Fallopian tube and meet the ovum near the outer end of the tube Here it burrows through the wall of the ovum, if present, unites with the contents and a pregnancy is started For several days, probably a week or longer, the fertilized ovum slowly passes down through the Fallopian tube and, when it reaches the uterus, it has developed to a state where it attaches itself to the inside wall of the uterus and begins to grow

The uterus is a hollow organ about the size and shape of a pear with the stem end entering into the vagina The wall of the uterus is composed of muscle tissue with an extraordinary power to distend and stretch as the embryo increases in size After a period averaging nine months and five days from the first day of the last menstrual period, the fetus is fully developed and

the muscle wall of the uterus starts to contract Assisted by the squeezing action of the abdominal muscles, the mouth of the uterus dilates and the baby is forced through the vagina and is born

Occasionally, it happens that the fetus may die from natural causes at any time during this cycle and is expelled by the uterus, causing an abortion Some of the most common conditions causing this are ill health of the mother, syphilis, malformations of the uterus and in some cases a woman will have repeated abortions for no explainable reason The terms *abortion* and *miscarriage* both mean the same thing, while if a fully formed baby is born dead at or near the time for its normal delivery, it is termed a *still-birth* A baby born after seven months of gestation may survive if given adequate medical care

Technique Employed.—It can readily be seen that anything which will destroy the life of the embryo, from the time fertilization takes place until the baby is able to live outside of the uterus, will cause an abortion In surgical practice where a lawful or therapeutic abortion is to be performed, the method used by the surgeon will depend upon how long the pregnancy has been established and the condition of the mother

If the pregnancy is not over two months old, the method most commonly employed is to thoroughly cleanse and sterilize the vagina and mouth of the uterus The opening into the uterus is then dilated and the fetus and after birth scraped out In a pregnancy of over two months, the surgeon would be more apt to dilate the opening of the uterus as before and then pack the interior of the uterus with sterile gauze This produces irritation to the inside of the uterus which in a few hours will generally start labor pains and expel the fetus along with the gauze In the late stages of pregnancy, by dilating the mouth of the uterus and rupturing the membranes which include the fetus, the fluid is allowed to escape This will start labor pains and accomplish the desired result Other methods may be employed for extraordinary conditions, but these are the common ones used

Criminal abortions are usually performed under conditions which would not be tolerated in a regular hospital In the first place, the woman is not prepared for operation as she would be for a regular surgical procedure The abortionist usually has no

assistant and it is therefore impossible to carry out sterile surgical technique A curetting may be done, or the uterus packed with gauze, and the victim sent home with no scientific aftercare whatever While the uterus has great powers of stretching, nevertheless the uterine wall offers very little resistance to a curette or other surgical instrument, and it is very easy for such an instrument to penetrate the upper end of the uterus directly into the abdominal cavity This causes bleeding and opens up a direct avenue for infection which is the cause of many deaths

The usual cause of death in such cases is peritonitis (inflammation of the abdominal cavity) though there are many cases on record of death due to other infections, such as lockjaw

Abortionists use many other methods in addition to those mentioned Some will dilate the uterus and inject iodine or other highly irritating substances to cause uterine contractions Others will inject slippery elm sticks which will swell and cause irritation to the uterus There are several devices by which electric current is used to irritate or stimulate the uterus and will result in contractions One of the oldest methods is to insert the tip of a rubber catheter into the uterus and tape the other end to the inside of the thigh Walking will then cause the catheter to move up and down inside the uterine cavity, and in a day or two an abortion will result

Various types or irritating pastes have come into wide use for this purpose The most common one is a soapy type of paste containing potassium iodide, thyme and other ingredients It is supplied in a tube similar to shaving cream to which is attached a small stem that can be inserted into the cavity of the uterus Some of the paste is then squeezed in and the stem withdrawn This will set up an irritation, causing an abortion These products are widely used and are highly dangerous In some cases death will result within a few hours after their use due to the rapid absorption of the paste into the blood stream

As dangerous as these methods are, the means some women will use themselves to try to produce an abortion are even more hazardous There are many cases of women inserting all sorts of devices into the vagina and uterus, lead pencils, hat pins, wires and catheters There is almost nothing which is long and pointed which has not been employed for this purpose, often

with disastrous results Under such conditions there is generally no antiseptic technique whatever the instrument used frequently does not enter the uterus at all but is plunged up in back of the uterus into the abdominal cavity where it may perforate the intestines or other organs Death from infection under such circumstances is common

Potassium permanganate has been employed in the form of a douche and deaths have resulted from its use In some cases the tablets have been inserted into the vagina where they are exceedingly irritating and generally cause serious bleeding within an hour or two In other cases quantities of the tablets have been dissolved in water to make a very concentrated solution which was then given as a douche causing death in a few hours Jetter and Hunter report that postmortem examination revealed that death was due to a rapid breaking down of the red blood cells within the blood vessels producing extensive kidney damage shock and collapse of the circulation

Recently a woman inserted the tip of an atomizer into the uterus and pumped a considerable quantity of air into the cavity She died shortly afterwards due to a large bubble of air entering one of the veins and floating free in the blood stream (air embolism)

Drugs Commonly Used to Produce Abortion —Drugs to be taken by mouth for the purpose of ending pregnancy are almost without number *It may be stated that there is no drug which will consistently terminate pregnancy without the risk of serious harm to the patient* One of the most common procedures is taking castor oil and quinine and in the early months of pregnancy this is seldom successful Ergot likewise is taken in many forms and generally without result The taking of enough ergot to produce an abortion is apt to cause serious poisoning Apiol is another drug similar to ergot and is likewise dangerous There are other drugs which are irritating to the genital tract such as cantharides or Spanish Fly This drug is highly dangerous and has caused many deaths There are many nostrums on public sale and advertised in magazines for such conditions as delayed menstruation which have no other purpose than to produce abortion In general they are unsafe dangerous to the patient and usually without the desired effect

INVESTIGATION OF ABORTION CASES

As has been previously stated, death following criminal abortion is generally caused by peritonitis The usual sequence of events is about as follows

A woman, having missed one or two periods, realizes she is pregnant For anyone of a multitude of reasons she wants the pregnancy ended She finally reaches an abortionist who either curettes or packs the uterus with gauze or paste and sends her home Following this she has violent abdominal pains, with considerable bloody discharge, which may become very foul After two or three days she may have a chill and develop a high fever Usually, she is reluctant to call a doctor and she even more dreads going back to the abortionist Consequently, she is seriously ill for several days before she gets into the hands of a reputable physician By this time peritonitis is well developed She is taken to a regular hospital and after a few more days in which she is in a desperate condition, she either begins to recover or dies Usually the police officer has no knowledge of the situation until after death has occurred, and under such circumstances the chances of successfully prosecuting the abortionist are slim *If the true situation can be ascertained prior to death, then it is vitally important to obtain a dying declaration* Generally women who realize that they are going to die are willing to tell the truth about the cause of their condition

Another obstacle to a successful prosecution in the event that the victim is married, is that the husband frequently has gone with his wife to the abortionist, given his consent to the operation and has paid for it Consequently, in the eyes of the law he is just as guilty as the abortionist himself, and realizing that, he usually prefers to bear his grief in silence rather than create trouble which would involve himself If the girl is unmarried, the parents shrink from any criminal procedure which would publicize their daughter's shame

In the event that the abortionist is arrested and charged with the unlawful death, his defense follows a common pattern It is usually to the effect that the woman had already had a miscarriage before she came to him, and that he merely scraped out the afterbirth, or that he curetted her for some obscure bleeding,

and did not know that she was pregnant. Without a dying declaration it is almost impossible to obtain a conviction.

MEDICAL NOTES ON ABORTION DEATHS

The bodies of women dying following abortion should be autopsied completely. It is particularly important that the uterus and other genital organs be carefully removed and preserved for microscopic examination Usually the scraping marks of the curette can be readily identified, particles of afterbirth tissue are still attached to the wall, and the site of a puncture wound of the uterine wall may be determined

In the case of deaths occurring a few hours after the injection of paste into the uterus, it is well to obtain a specimen of blood for a chemical determination of potassium The amount of potassium in the blood will be greatly increased in these deaths and the actual cause of death in such cases is generally edema (water-logging) of the lungs.

Chapter 18

Examination for Suspected Sexual Assault

When the dead body of a woman or young girl is found, the question often arises as to whether rape was committed in connection with the homicide Regardless of the actual cause of death, it is of extreme importance that the body, clothing and the immediate area where the body lies remain undisturbed until a proper investigation can be made This is important for determining whether or not a sexual assault took place and for preventing evidence from being destroyed which might identify the assailant

Rape alone seldom causes death immediately, although extensive lacerations of the female organs may become infected and cause death a few days later Death usually results from some form of violence used in overcoming the resistance of the victim to the sexual attack Frequently the cause of death is asphyxia due to choking, smothering, strangulation with a mouth gag or similar violence Occasionally stabbing, cutting or bullet wounds will be the cause of death The officer should bear in mind that a woman or child will sometimes be murdered and then raped after death To accomplish the crime of rape it is not necessary that the penis penetrate deeply into the vagina In most states the courts have held that merely insertion between the labia which are the folds of skin covering the opening of the vagina, is sufficient to constitute the crime

Definition of Rape —Rape is the crime of a person other than the victim's husband having sexual relations with her under the following conditions

1 Against her consent

2 While she is unconscious, or under the influence of alcohol or drugs so that she does not realize what is taking place

3 With a child who is under the age of consent as fixed by statute This age of consent varies in different states, in some being as low as 10 years In most states, however, the age of consent is set at 16 years

4 With a feeble minded or insane individual

Many officers believe that it is practically impossible for rape to be committed against a woman of normal size and physique unless she partially acquiesces This is true only in so far as the fear caused by the display of a dangerous weapon accompanied by a threat of murder may easily cause acquiescence, if not actual cooperation, to the completion of the act

GROSS INDICATIONS OF RAPE

The indications of rape may vary widely depending largely upon the age and size of the victim and whether or not she was accustomed to sexual intercourse

Evidence of Rape of a Child —It is generally simple to determine if rape has been committed when the victim is below the age of 12 years If there has been a forcible entrance of the penis into the vagina, tearing of the vaginal opening accompanied by bruising and bleeding will be evident It is usually necessary that the assailant either secure the arms and legs with ropes or *render the child unconscious in some manner to accomplish the* act In addition there are usually stains of blood and semen on the clothing which make the crime evident

Evidence of Rape in the Young Woman or the Woman Unaccustomed to Sexual Relations —When such a person has been the victim of a sexual assault, evidences of the act are usually present although not as pronounced as in the case of the small child If there is not actual tearing of the tissues about the opening of the vagina there are usually abrasions, swelling, and black *and blue areas Bleeding may be extensive or it may be entirely* absent Evidence of semen may usually be found in the vagina, on the body, on the clothing or on the surface where the body is found lying

Evidence of Rape in the Woman Accustomed to Sexual Intercourse —These cases offer the greatest difficulty to the investigator and medical examiner If the woman offered considerable resistance to the act, there will usually be some evidence of

injury about the vaginal opening. However, failure to find traces of injury does not rule out the possibility of a sexual assault.

EVIDENCE OF SEMEN IN THE VAGINA AND ON THE BODY

When rape has been committed against the child or virgin, evidence of bleeding and tearing of the tissues is usually so pronounced that there is no doubt about the act having occurred. But in the case of the woman accustomed to intercourse, and particularly if she has borne children, it is often impossible to tell with certainty from the physical appearance of the body if she has been sexually attacked. It then becomes of paramount importance to find traces of semen if they are present.

Semen is a colorless tenacious fluid. Swimming in it are thousands of minute organisms known as *spermatozoa* (commonly called sperms). Under the microscope each sperm looks somewhat like a miniature tadpole, if the tadpole's tail were 5 or 6 times longer. Finding spermatozoa in the vagina of a woman who is accustomed to intercourse may or may not be evidence of a sexual assault, depending largely upon how long previously she has had intercourse.

Evidence of Spermatozoa in the Vagina.—In the living woman very few reliable observations have been made upon the length of time that spermatozoa may be found in the vagina after intercourse. Some observers have reported finding spermatozoa in the vagina after seven hours while others have reported finding them as long as 48 hours after intercourse Formerly it was believed that spermatozoa disappeared very rapidly in the vagina of a dead body. Recent evidence indicates that under certain conditions sperms may be identified for at least several days after death. In the rectum sperms disintegrate much more rapidly but even there it is possible to identify them after a much longer time than was formerly supposed.

Spermatozoa on Clothing or Surrounding Objects.—When semen dries on clothing or similar articles the stain usually has a starchy appearance but if it is small it may be very difficult to find. The use of an ultra-violet light greatly facilitates the search for these stains. Viewed under this light, a stain due to semen

glows and it is very easy to mark out the suspected area. The laboratory expert may then apply certain tests which will definitely determine whether the stain is due to semen or some other substance. Recently the acid phosphatase test has come into common use and is a great improvement over previous methods of testing for semen.

The properties which make it possible to tell in what blood group an individual belongs are also present in the semen. Therefore if a sufficient amount of semen can be obtained it may be possible to determine to which blood group the assailant belongs. Consequently if semen were found to come from a person belonging to a certain blood group and a suspected individual belonged to a different blood group, he could be eliminated from suspicion. However, if both belonged to the same blood group, it is not proof that the suspect is guilty, as many other persons who might have committed the act may belong to the same group.

EXAMINATION OF CLOTHING OF THE VICTIM AND SUSPECT

In addition to the examination of the victim's clothing for semen stains, a very careful search should also be made for fibers of clothing belonging to the suspect. Likewise the clothing of the suspect should be carefully examined for minute fibers of the victim's apparel If the suspect is guilty of the assault, in a large percentage of cases fibers will be found on the clothing of one which can positively be identified as having come from the clothing of the other.

A country school teacher was walking home on a lonely road when she was attacked under a railroad bridge Being late in the fall it was dark and she could not see the features of her assailant. She was wearing a wool sweater which was dyed a peculiar shade of blue and the strands of which had an unusual twist. Purely on suspicion a farm hand who lived near-by was taken into custody and his clothing examined. On the front of his overalls were found several tiny fibers These were examined under the comparison microscope and were found to be identical to those in the girl's sweater. Confronted by this evidence the farm hand confessed, although it was two days after the assault before he was apprehended.

Furthermore, the clothing of both victim and suspect should be carefully searched for evidence of soil, grass fibers, burrs and other material which may be peculiar to the particular locality where the crime was committed. To properly conduct such an investigation, the clothing of both victim and suspect must be carefully examined; first, under an ultra-violet light to search for semen stains and, second, with the use of a hand lens under a strong light, to hunt for other pertinent evidence If the suspect is guilty, the evidence is almost always present but careful, painstaking study is necessary to find it.

EXAMINATION OF FINGER NAIL SCRAPINGS

When the victim has offered resistance to a sexual assault, in a considerable proportion of cases she will be scratched and skin will be gouged out by the finger nails of her assailant Consequently, important evidence can often be obtained by a careful examination of the finger nail scrapings. If the suspect is actually the guilty party, minute particles of skin, blood, hair and cosmetics can often be found and sometimes positively identified as having come from the victim. Small fibers may be found which can be identified as having come from the victim's clothing. Likewise the nail scrapings of the victim should be carefully examined in the laboratory as material may be obtained which definitely indicates the guilt of the suspect.

In taking finger nail scrapings from a suspect never use a knife, nail file or hard sharp instrument. It is apt to cause bleeding and scrapings of the nail contaminate the sample. The best instrument to use is the blunt end of a wooden toothpick. Collect the scrapings on clean sheets of white paper or in a clean glass petri dish.

MEDICAL NOTES

1. Following a suspected sexual assault, it is important that a careful examination of the victim be made as soon as possible. Frequently police officers bring the girl to a doctor and insist that an examination be made immediately. *If the victim is a minor, under no circumstances should the doctor make such an examination unless a parent or lawful guardian of the victim is present or has otherwise consented to such an examination.*

They are the only persons who can lawfully authorize such a procedure To make such an examination without their consent might make the doctor liable to a suit for malpractice

2 If the physican does not have suitable equipment for making such an examination, it is best to take the girl to a place where the proper facilities are provided, or wait until the doctor can procure the necessary supplies

3 Washings with normal salt solution should first be taken from the vulva and perineum of the victim, collected into a clean small bottle and labeled Next, a similar washing should be taken from the vaginal vault This is done by directing a small stream of salt solution into the vagina from a wash bottle such as is used *in a chemical laboratory However, before the salt solution* is directed into the vagina the doctor should try to withdraw the vaginal contents with a pipette If this can be done, it should be placed on a slide and examined microscopically The washings obtained should then be taken to a laboratory where they can be centrifuged The sediment should then be examined microscopically in an effort to find spermatozoa

4 If the victim is dead, the examination should be conducted in the same manner as previously outlined If the body has already been embalmed and washed by the funeral director, it is wise *to cut off samples of hair around the vaginal opening* Spermatozoa may be found clinging to these hairs even after the body has been prepared for burial

5 If a suspect is in custody, he should also be examined This examination consists of directing a fine stream of salt solution on the head, corona, and under the foreskin of the penis The drippings are collected, centrifuged and examined as are the vaginal washings

If the attack has taken place only a few hours before the examination, spermatozoa will usually be found in the washings *In addition* there may be recovered other inclusions such as trichomonads pollen granules, vegetable or clothing fibers and other material which may definitely tie the suspect to the crime

Should the victim show evidence of tearing and bleeding about the vagina do not fail to run a benzidine test upon the genitals and pubic region of the suspect, similar to the method described in Chapter 4 The only difference in the technique is

that the acid solution should not be applied directly to the skin Use clean cotton swabs moistened with hydrogen peroxide or perborate solution and apply these to the skin of the penis and pubic region The test may then be carried out by later transferring the swab to clean filter paper or by applying the reagent material directly to the cotton swab This should be done even though the suspect has bathed and two or three days have elapsed since the attack Always be sure to run controls on the skin of parts of the body which could not have become blood stained by the attack

6 At the time of the examination finger nail scrapings should be taken from both the victim and the suspect These are best collected in a clean petri dish which can be covered and preserved until a competent microscopist can examine it for skin remnants, blood fibers and other particles

Chapter 19

Management of the Sensational Murder Case

Sooner or later nearly every community becomes involved in a murder which arouses widespread attention Reporters from all over the country flock in to cover developments Large rewards are offered for information that will solve the case. The local community is aroused and frightened and all police agencies are put under terrific pressure to bring the investigation to a speedy conclusion.

Too often there has been no thought or preparation given on how to handle this situation Several different police agencies may be involved and are working more or less independently Jealousies arise between them and not infrequently they seem to be working in competition with each other rather than in a co-ordinated effort. Each is making its own statements to the press, interviewing the same witnesses and appears to hope that it will be the lucky one to solve the case and grab the headlines

It is not surprising that frequently the murder remains unsolved Several questions naturally arise as to how to meet this situation and bring about a solution to the case Who is to take charge? Who is to give publicity releases? What is to be the method of procedure? What part are reporters and other interested persons to be allowed to take in the actual investigation?

The Commanding Officer.—Regardless of where the murder may take place—in a large city, a village, or in a wilderness, the chief law enforcement officer is the prosecuting attorney The ultimate conviction of the murderer is his responsibility and he should be the general-in-command of the co ordinated efforts of all law enforcement agencies to bring about the solution

Frequently the prosecuting attorney has had no specialized training in homicide investigation, has been in office only a

short time and has no intention of making a career in this particular field He has myriad other duties requiring his attention at the same time and it is impractical for him to personally direct every phase of the investigation In that event it is imperative that he appoint an officer to be in complete charge of the details but who is directly responsible to him and with whom he confers at frequent intervals

If in a large city logically that person would be the Chief of Police If in a small community or rural area it might be the Sheriff or an officer of the State Police In any event the important thing is that *the prosecutor should call in the heads of the various organizations discuss the matter with them let them know who is to be in charge and secure their co operation to work in a co ordinated effort*

Some will say that human nature being what it is it is impossible to secure that type of overall direction That may or may not be true but the fact remains that entirely too many sensational cases end up in a complete fiasco simply because there was a failure to secure that type of co operation In one case in which I was personally concerned a situation developed in which the various police organizations involved were actually hiding evidence and witnesses where the others couldn t find them or know anything about them

The Captain in Charge —Whomever the prosecuting attorney designates to be in charge of the details of the investigation must be provided office and stenographic facilities He is the one who has direct control and assigns the other agencies and officers their particular roles in the investigation For example it is important that the collection of all scientific evidence laboratory material and such items be under the control of one man who is assigned by the captain All statements of witnesses should be under the direction of another who is an expert in this field It is his duty to see that they are properly taken and filed It will be necessary that the captain and the prosecutor interview some of these personally and in many cases the prosecuting attorney may want to take his own statements

Photography is best handled by one expert rather than having several different persons taking photographs which may have little value

The coroner or medical examiner has charge of the autopsy

and other evidence found on or in the dead body and naturally functions within his own domain.

It is likewise the duty of the captain in command to personally see to it that all articles concerned with the case are properly collected, labeled, photographed and filed Entirely too often these items are scattered and when the case comes to trial several months later nobody knows where they are, who found them, or exactly what connection they have with the case *Each item must be tagged, listed and numbered with an identification mark by the officer who collected it.* This tag must contain all pertinent information about the article such as when and where found and by whom, whether or not it was sent to a laboratory for examination, was bloodstained, or contained fingerprints All of this information should likewise be recorded in a notebook by the person designated by the captain

Press Releases and Public Relations.—During the course of a murder investigation the news items appearing in the press and on the air may be very helpful or harmful largely depending upon how much preparation has been given to what is to be said and who is to say it Reporters may be all over the area involved taking their own pictures of witnesses and other evidence Some will come in from distant places and they have to file a story every day. They are naturally anxious to interview everyone involved and get as complete coverage as possible In some cases the reporters are told virtually nothing and in others every investigating officer seems anxious to get his name in the papers

It is a mistake to completely shut off reporters from news concerning the investigation because frequently they can be exceedingly helpful in uncovering information which is valuable to the case If the investigation is well organized and is operating smoothly there is no reason why they should not be appraised of developments as they occur. However this information should come from the captain in command or from the office of the prosecuting attorney and not from the officers who are actually working on details of the investigation News items given to reporters by others working on the case are often a source of trouble. Jealousies are created or information given which embarrasses other phases of the investigation and confusion results.

Particularly if no suspects are in custody it is well for the

FIG 148 *The hazard of eyewitness identification* Shortly after a vicious sex crime during which a manacle was used to bind the victim the tall man on the left was arrested and held as a suspect He was *positively identified* by both the victim and a clerk in a store who said she had sold him the manacle a few days before the crime was committed This and other evidence convinced the police that he was guilty of the crime and they announced that fact in the press Fortunately in connection with a narcotics investigation the man on the right was apprehended and he proved to be the person guilty of the sex crime As in this case it is common that persons who are wrongly identified bear little resemblance to the actual criminal

captain or prosecutor to remember to withhold some of the details discovered in connection with the evidence As mentioned in the Chapter on Criminal Interrogation if every minute item in connection with the evidence has been published in the papers it is much more difficult for the interrogator to determine the truthfulness of statements given to him by the suspect

For example a revolver may be recovered which might be the one used in the murder. That is a piece of information which can properly be disclosed to the press. However the fact that a large chip had been broken off the handle would be a good item to withhold for use in future interrogations

In recent years it has been my experience that reporters are co-operative about withholding information the disclosure of which might be harmful. Most of them have a sense of public duty and will usually help if given information by the captain so that they know what is happening. In general the chances for a successful outcome of the investigation are improved by being completely frank with the press so that they know what is going on and request that they withhold certain information which may be premature.

Rewards for Information.—In nearly every important case rewards are offered for information which would assist in convicting the guilty person Generally the authorities are consulted as to whether or not such rewards are desirable and if so how they should be administered

In my experience such rewards cause more trouble than they are worth. When a reward has been offered I don't know of a single case that was solved when it wouldn't have been solved just as rapidly without the reward Generally they stimulate a flood of spiteful and crack-brained tips all of which have to be checked out. It is extremely rare that any solid information is sent in which would not have been offered anyway However it is important that if a reward is offered that all those officially participating in the investigation should be excluded In one important case where the officers participated under the terms of the reward the investigation resulted in chaos and is still unsolved

False Confessions.—Strangely one of the things that confuses the investigation of many sensational cases is a false confession Certain people have such an urge to be the center of attention complete with their picture in the paper that they will voluntarily confess to a sensational murder to bring that about Often the individual making the confession is of such a peculiar type that the officers believe that he might well be the actual murderer. These confessions delay and disrupt the whole procedure as each one has to be carefully checked. In one sensational west

coast case which is still unsolved there have been over thirty of these bogus confessions The principal thing to bear in mind is not to allow the entire investigation to come to a halt when one of these incidents takes place but to proceed with all details until the truth or falsity of the confession is determined

Avoid These Common Errors—Be guarded about making predictions regardless of what the probabilities appear to be at the moment A very common one is a statement such as this—"We know who the murderer is and will have him in custody within 24 hours"

A statement of that kind is entirely unnecessary and often backfires with disastrous effect Likewise avoid making comments respecting the guilt of a person who is in custody Remember that a jury is going to make that determination and it is not necessary for the investigating officers to try to sell the public on his guilt In a recent sensational case the chief investigating officers were quoted in the papers substantially as follows—"The evidence against John Doe is complete There is not the slightest doubt about his guilt' A short time later the actual criminal was apprehended which placed the entire Police Department in a very embarrassing situation Actually the officers had done some excellent investigative work on this case but suffered a serious loss of prestige by statements which should never have been made

Posing for Photographs—There are other common practices which while not necessarily fatal to the outcome of an investigation had best be avoided Photographs of the investigating officers while carrying out their duties do no harm but posing for photographs is something to be avoided *Never pose for a photograph with a dead body* Such a photograph can do no possible good and only conveys the inference that the officer has little idea what he is supposed to do

Likewise *never pose for a photograph with a suspect who is in custody* It is prejudicial to the rights of the suspect who even though he may have confessed is still presumed innocent until his guilt has been determined by a court of law Such photographs sometimes get into the hands of defense attorneys with devastating results Such pictures serve no useful purpose and may later prove extremely embarrassing

Finally.—If a methodical investigation is conducted along these lines it becomes immediately apparent to the press and the public at large To a great extent this relieves the pressure on the investigating officers to solve the case at once—make an arrest and secure a conviction The resulting frenzy and confusion creates conditions under which innocent persons are most likely to be convicted

It may be two, three or more years before there is a break in the case and the solution becomes apparent By that time there may be a new prosecuting attorney, officers transferred or retired and the public may have largely forgotten about it However when the break comes the solution is greatly facilitated if there is an orderly and complete file of all statements and evidence collected at the time of the original investigation

CHAPTER 20

Popular Fallacies in Homicide Investigation

INVESTIGATORS in this field occasionally encounter certain beliefs which are erroneous In a certain sense many of these ideas are as harmless as they are unscientific It is important that the police officer be acquainted with these beliefs, as a recognition of these fallacies serves to clarify some unexplained fact which has appeared in the course of the investigation Consequently time, energy and money can be conserved by an understanding of these popular misconceptions Some of the more common beliefs which are without scientific foundation are as follows

1 *Murder Will Out*—If this were only true there would be no purpose in writing this book While feature writers stress the theme that the perfect murder has never been committed the fact is that *the number of unsolved homicides is enormous.* Based on the number of murders discovered after the victim has been dead for years, it is only too apparent that many victims are buried and a homicide never suspected in connection with their deaths

2 *Permanently Fixed in the Eye of the Deceased is the Image of the Murderer*—Many people believe that by looking into the eye it is possible to see who committed the deed This is entirely without scientific foundation and is impossible In one investigation in which the writer participated, following the murder the assailant took the clothes and shoes he was wearing at the time and went several miles back into a swamp where he hid them under a stump The reason he did this was that he feared the clothing would identify him as the murderer by means of the image in the victim's eye

3 *The Murderer Always Returns to the Scene of the Crime* While this happens in some cases, it is by no means universally true Occasionally officers stand watch at the scene of a murder for days waiting for the murderer to put in his appearance They are generally disappointed

4 *The Hair and Nails on a Dead Body Continue to Grow after Death*—For growth to take place at any time, nourishment has to be provided to the cells by the blood stream in the form of food and oxygen After the heart stops beating, this supply of nourishment ceases and while some cells in the body will survive longer than others, all cellular life ceases in a short time Consequently, it is impossible for growth to take place in a dead body The appearance of growth around the nail bed and roots of the hairs is due to shrinkage of the skin as moisture is absorbed out of the body The exposed portion of the nails and hair previously covered by skin may lead one to think that growth has actually taken place

5 *A Drowning Person Goes under Twice and the Third Time Stays Down*—A drowning person may disappear the first time he goes under, or he may continue to struggle over a considerable period of time until asphyxia renders him unconscious

6 *Expressions of Surprise, Fear or other Violent Emotions Will be Fixed on the Victim's Face*—Except in extraordinary circumstances, death produces a general relaxation of all muscles The most common exception to this is cadaveric spasm which will cause a weapon to be tightly clenched in the dead person's hand This does not often apply to the muscles of expression, therefore the features assume a completely relaxed appearance

7 *A Dead Body May be Quickly Destroyed by Burying in Quicklime*—While this chemical is a strong caustic, it does not tend to rapidly destroy a body—if anything it tends to preserve it It forms a combination with fatty tissue which is resistant to insect life and to the usual putrefactive changes which destroy tissue

8 *A Gunshot Wound Through the Heart Causes Instant Death*—This is a common belief and totally erroneous as explained in Chapter 7 on Homicide Due to Gunshot Wounds

Persons will sometimes do amazing things after receiving a bullet wound through the heart.

9. *A Photograph Never Lies.*—Many conditions may affect a photograph and cause it to give a totally erroneous impression. The use of certain lenses, the height of the camera above the floor or ground, the type of film, the distance from the object are some of the conditions which may produce effects at variance with the actual situation. In addition, it is a simple matter for a skilled photographer to remove or change images on the negative. Nothing is more helpful to the investigation than the services of a good photographer and nothing more confusing than distorted and poorly exposed pictures

10. *Clairvoyants, Fortune Tellers and Mediums Can Give Valuable Information with Respect to a Murder.*—It would be wonderful indeed if it were possible to solve a homicide by contacting the departed spirit and having him disclose the facts in the case. The amazing thing is that even today police officers often try to derive information from such sources I know of no case where any valuable information was obtained by such methods. Such a consultation generally indicates an attempt to repair the damage caused by an inadequate investigation at the time the body was found

11. *Dead Men Tell No Tales.*—Too often this is true *How much they tell may be in direct proportion to the care, diligence and conscientious effort that the investigators and the laboratory technicians apply to the investigation.* Sometimes the dead man actually becomes eloquent As the science of homicide investigation advances, dead men will tell more and more.

Chapter 21

Why I Wrote This Book

A FEW YEARS ago I received a telephone call from the prosecuting attorney of one of the neighboring counties He asked me if I would come over and assist the local officers on a murder case I left at once and met him that afternoon at his office where he explained the situation

The victim was the middle aged wife of an official in one of the automotive plants They lived in a bungalow type house on the outskirts of town adjacent to a golf club On the forenoon of the previous day a newsboy came to collect for the paper and on receiving no response to his knock at the front door, he walked around to the rear door through which he could look directly into the kitchen Lying on the kitchen floor surrounded by a pool of blood, he saw the victim's body The local police and coroner were notified At the time, the victim's husband was at work at a plant some thirty miles distant

The coroner and police officers arrived and made a superficial investigation No notes were made in writing, no photographs were taken, no finger prints or other evidence were searched for or obtained Dirty dishes were noticed in the sink Blood was spattered over the floor and woodwork in the kitchen From the kitchen a trail of blood led out the back door along the driveway to a spot where the family automobile was frequently parked The outer clothing of the woman was saturated with blood and had been thrown into the sink and the water allowed to run on it In the bedroom it appeared that only one of the twin beds had been recently slept in and some articles of clothing were noted about the room

The body was then removed to the local undertaking parlor and a postmortem examination conducted by two neighborhood physicians This consisted of making a small incision and merely looking inside the chest cavity Their report was that death was

due to a penetrating stab wound of the heart No organs were removed or even detached, other parts of the body were not examined, and no attempt was made to see if a sexual assault had been committed Meanwhile the prosecuting attorney, whose office was only about four miles from the scene of the crime, was not notified of the murder and his first information that a crime had been committed was when newspaper reporters asked him for a statement late that afternoon

After the body was removed, two scrub women were sent into the house to clean the place They did a thorough job of it!! The blood was all mopped up except for a few flecks about the size of fly specks on the woodwork that they overlooked The dishes and other articles in the sink were washed and put back in the cupboard, the bed was made up, the pajamas and other clothing put away and the whole house put in order

A few days later some clues indicated that the family automobile might have been used in connection with the murder, but inasmuch as half a dozen people had driven the car in the meantime, the fragmentary evidence found in the car had little value A few flecks of blood were scraped off the woodwork for examination As these were a mixture of blood, paint, and general debris they had little value Without going into other details of the case, it is needless to say that this murder remains unsolved

This homicide naturally aroused great public interest and the newspapers featured it for weeks A suspect was arrested and charged with the crime At the preliminary examination there was no real evidence to present against the accused The police officers and coroner had no definite ideas as to when they were called or arrived on the scene of the crime Each had his own recollection of what he saw in the house, and there was considerable variation with respect to many details Very properly the accused was set free

During the years in which I have devoted a considerable proportion of my time to homicide investigation, many similar instances have occurred The realization has gradually developed that something definite should be done to try to reduce the frequency of these situations As in the case just cited, the coroner and police officers involved have all been conscientious, well meaning individuals and they have usually done the job to the

best of their ability. When exasperated by some of these situations I have thought to myself, "Why don't these people read or study something that will give them an idea of at least *what-not-to-do* when they have a case of homicide to deal with?" As I studied the situation further, I could find little in print which would be of any use whatever to a coroner or police officer The only books printed in English on the subject were very highly technical and too often unintelligible to anyone but a physician Consequently police officers, coroners and other investigators are limited in the amount of printed material which is of any use to them in their every day work

Thus it seemed to me that there was a definite place for a book that would explain simply and in the language of a layman how to proceed in the investigation of the usual types of homicide I have attempted to present this information in this book Realization of the need for scientific and accurate methods in this field is rapidly developing and improvement in technique is constantly taking place My sincerest hope is that this book may be of service to the conscientious officer and help to reduce the large number of unsolved homicides

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This Book

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By LeMoyne Snyder

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